

POPULAR SCIENCE

MARCH

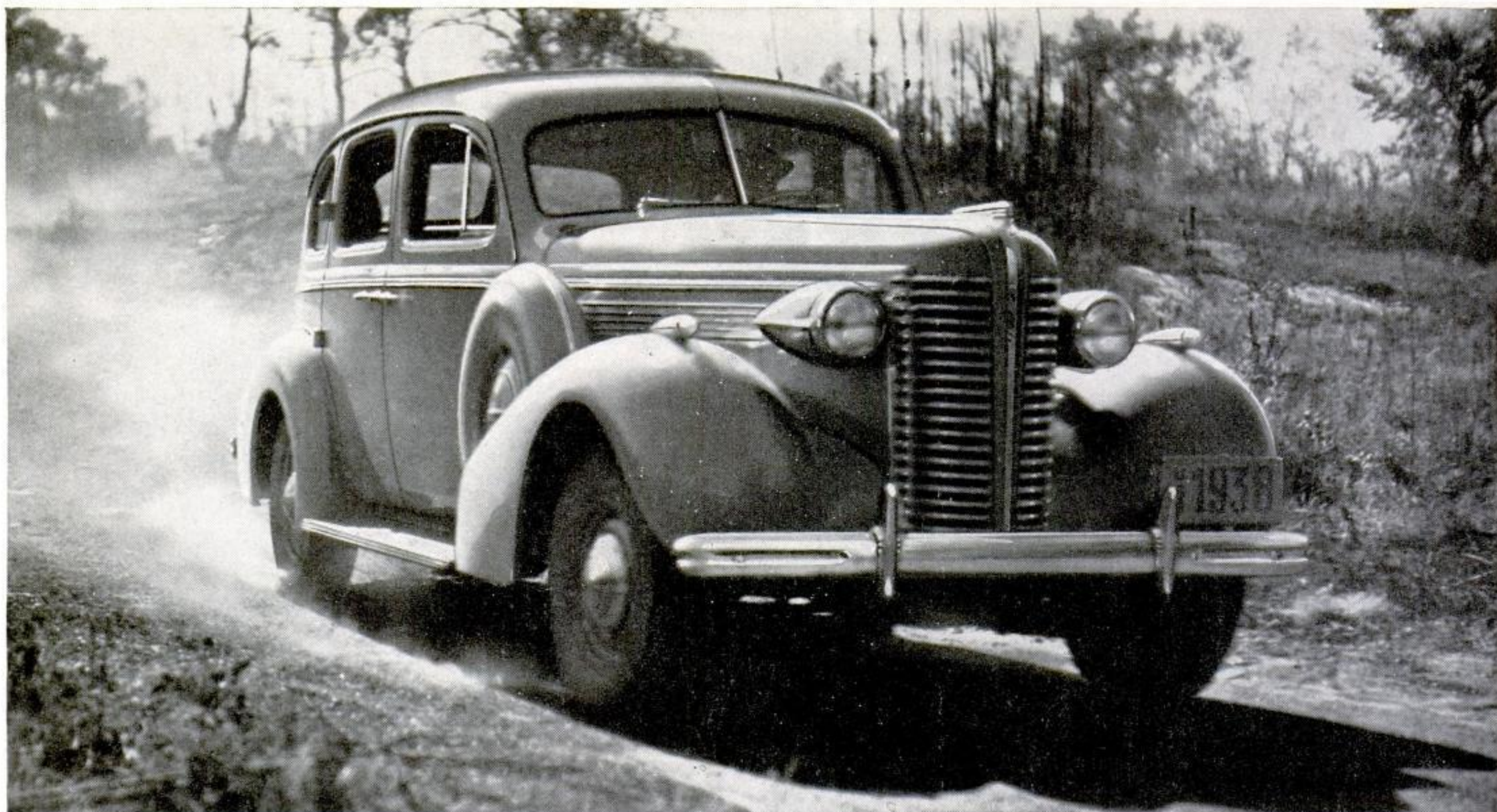
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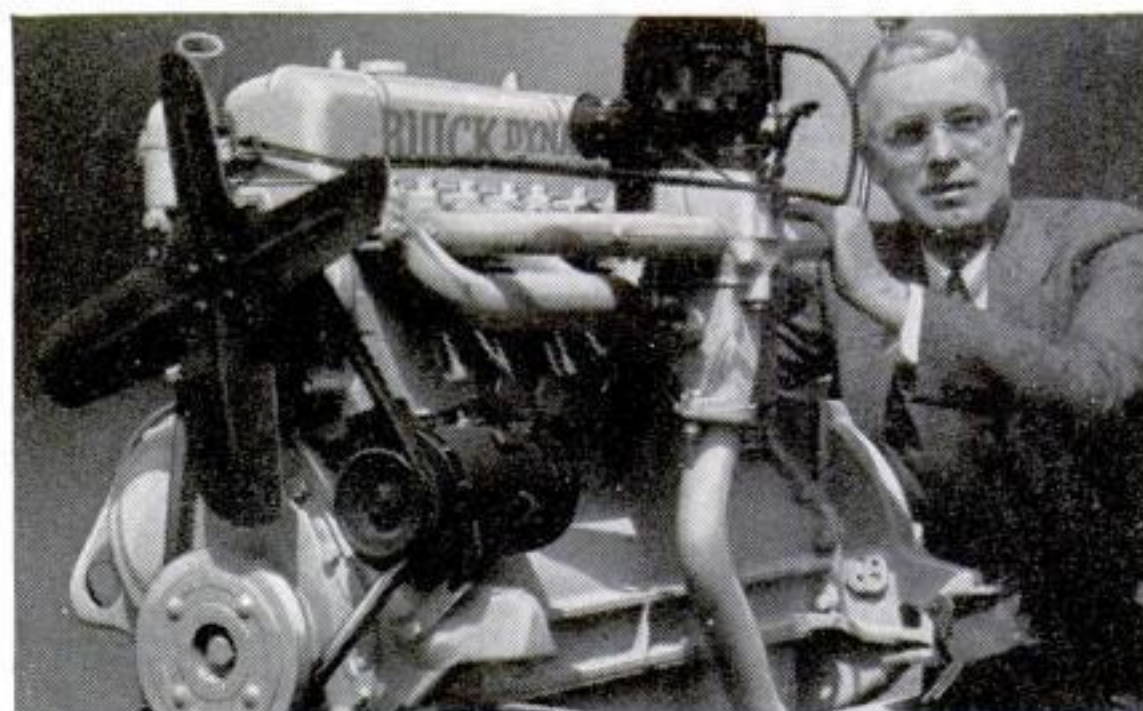
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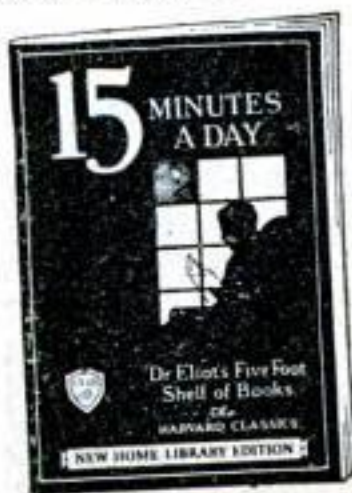
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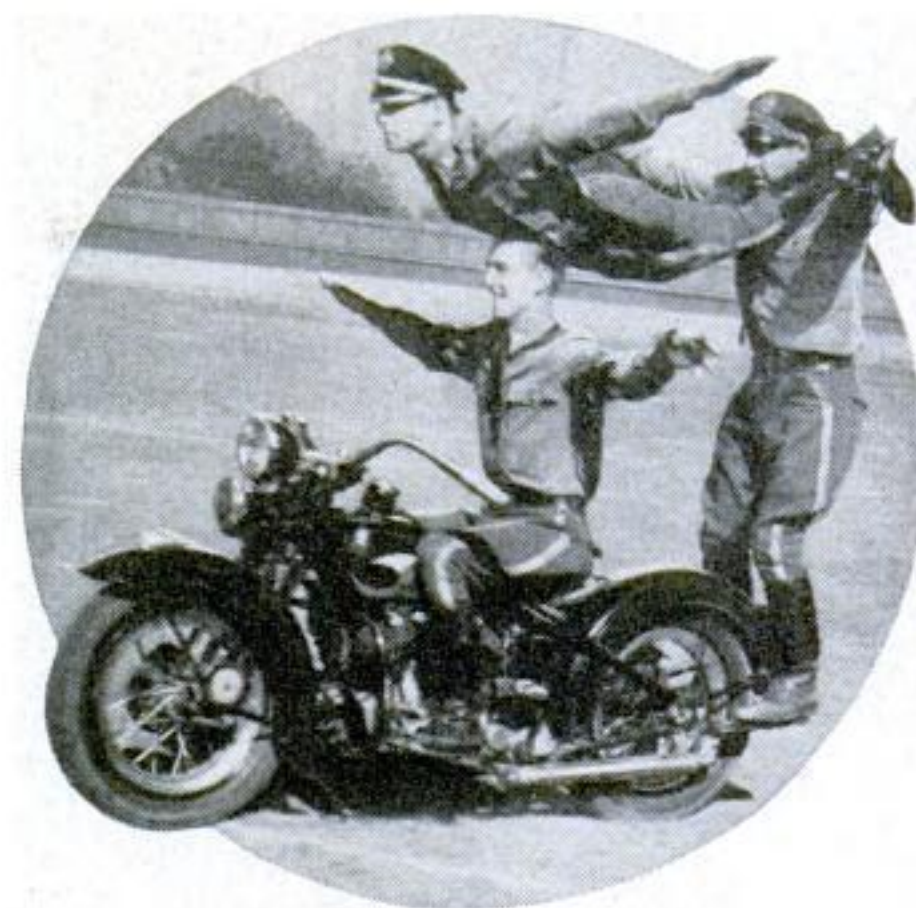
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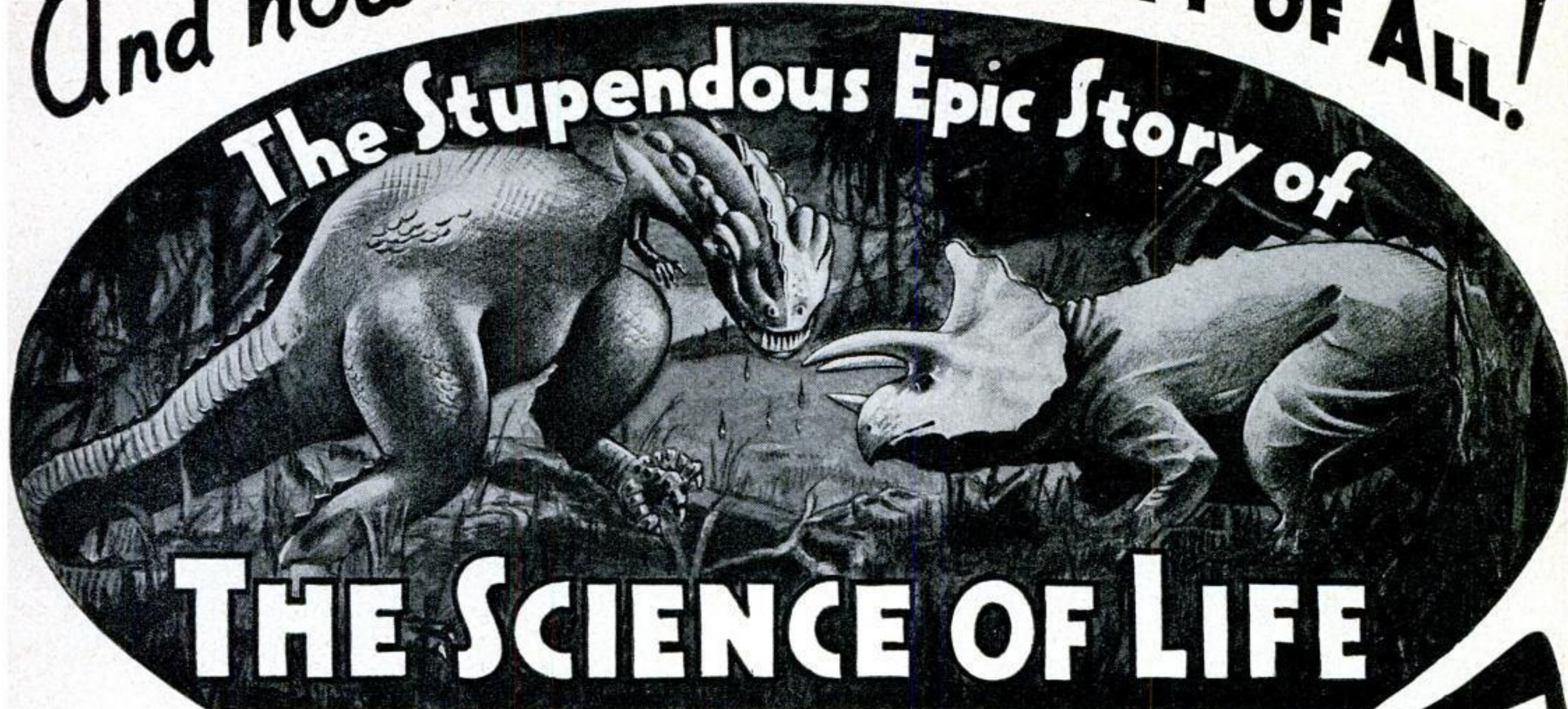
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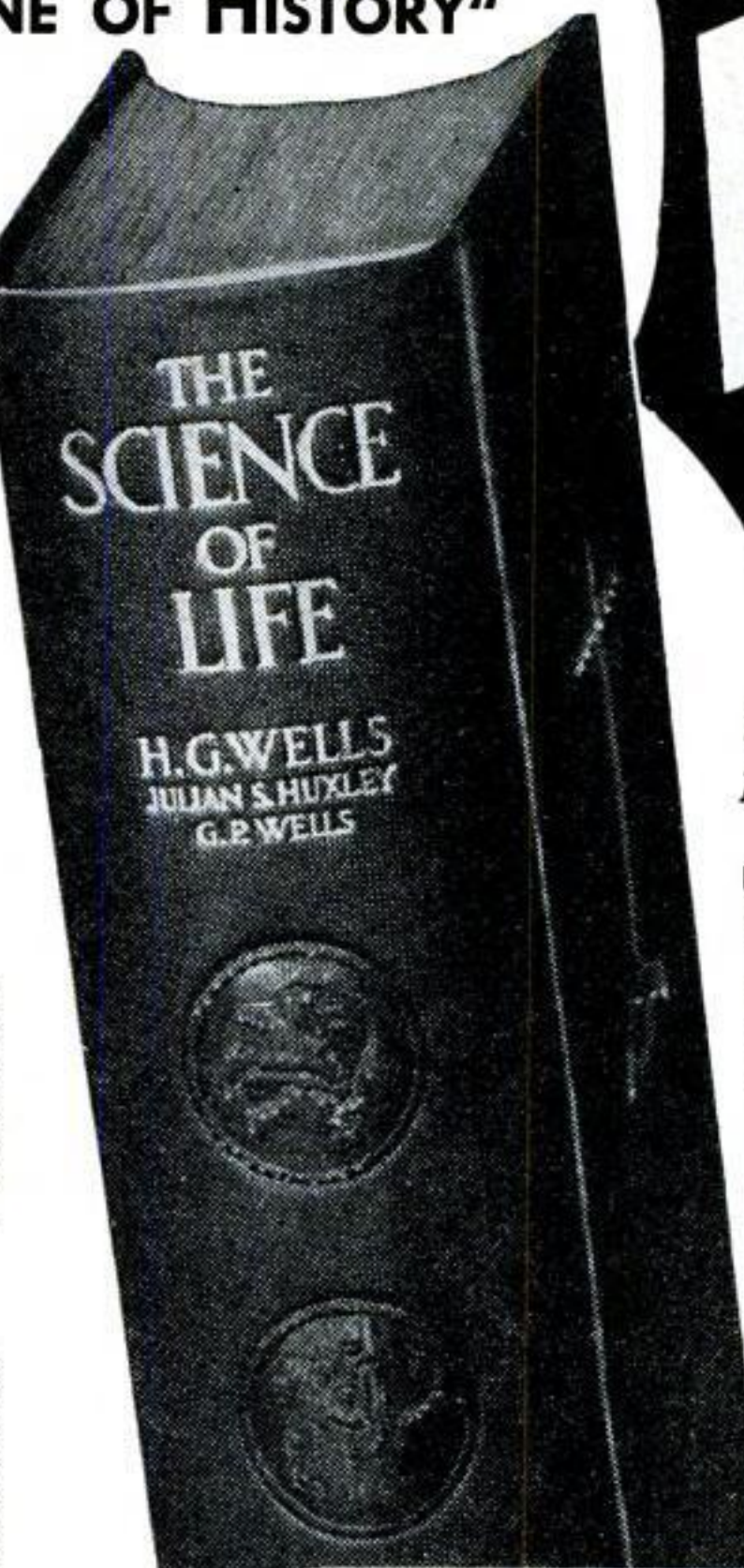
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SHE SAYS *"Please"* AND *"Thank You"*

THE alert, courteous voice of the telephone operator is known to all who use the telephone. To the little old lady in the shawl, the man in the big house on the hill, or a tiny tot of six, the words are the same, "Number, please" and "Thank you."

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Our Readers Say



But You Should Have Seen the Worm That Got Away!

IN "Un-Natural History," in a recent issue, it was stated that a five-foot earthworm is rather a thing to be wondered at. Well, perhaps it is to you folks. But to the anglers on the east coast of Australia, at least, a worm of the length referred to is—well, just a worm. Admittedly, our earthworms are considerably shorter than that—two feet would be a good length. But our sandworms, which are the usual form of bait for fishing here, are from three feet six inches to six feet in length. I have actually used a single worm for an entire day's fishing. With all that, I still want to say yours is a jolly fine magazine, and you don't slip up very often. I wouldn't buy the darn thing if it were no good, and I don't think the knockers would, either.—R.L.S., Brisbane, Australia.



We Came to the Aid of This Party!

I NEVER thought Pop. Sci. would come to my rescue as a party aid, but your new Question Bee provided swell fun at a little get-together that we gave recently. Before the party, we had twenty photostats made of the question page; one for every guest. Late in the evening, when the fun started to lag, we passed the sheets around and gave the crowd ten minutes to answer the questions. Then my husband read off the correct answers while each player corrected his neighbor's paper. To the winner we gave a year's subscription to our favorite magazine.—Mrs. P.N., Boston, Mass.

P. S. M. Is Unfair to Organized Organ Fans

J.D.V., of Philadelphia, Pa., has been waiting a "few months" for an article dealing with electric organs. I would like to enter into an agreement with J.D.V. and those other enthusiasts whose requests have appeared in your pages, that hereafter we will no longer embarrass you by asking you for such articles. We should realize that if knowledge of this intricate instrument was possessed by those on your staff, an article of this kind would have been forthcoming before the ravages of old age were upon us and we no longer could appreciate it. So there! Even if you do publish an article on the organs now, we're mad at you, and won't read it!—N.C., Great Falls, Mont.



An Elastic Connection Would Have Helped

VERY GOOD idea, that manifold-heating device for automobiles stored in unheated garages, described on page 59 of the February issue. Let readers who install it, however, profit by a sad experience of mine. I had a battery charger in my garage with a plug-in attachment like that on the heater. One cold morning I got in the car by way of the door opposite to the side where the electric cord was attached inconspicuously to my battery. In my haste, I forgot that I had connected the charger to the car the night before. Starting the engine, I backed out of the garage. The charger, which was screwed to the garage wall, followed me out—in pieces.—P.R.T., Utica, N. Y.

He Prefers the Old-Fashioned Parachute Rip Cord

IF I didn't like gadgets, I wouldn't be a reader of your excellent magazine. But the automatic parachute release you show on page 41 of your February issue looks to me like a plain case of misapplied mechanical ingenuity. It is just possible that a frightened plane passenger or inexperienced pilot, forced to bail out in a hurry, would have enough presence of mind to hold the little wind vane over his head like a parasol, but what assurance do you have that the Rube Goldberg assembly of shafts, gears, and pinions is going to work? I can imagine myself plunging downward through space, watching the earth gallop up to meet me, and wondering whether the mechanic hadn't possibly left out a gear or two when he put the thing together. If it's just the same to you, I'll stick to the old-fashioned rip cord—or, better still, keep both feet planted on good old terra firma.—R.A.D., Omaha, Nebr.



Bright Reader Explains J. Y.'s Mystery Lamp

REGARDING the mystery lamp which J.Y. asked about in the January issue, it is no mystery to the initiated, such as the short-wave radio fans. A powerful oscillator was probably placed near the bulb but out of sight. When it was in operation, it emitted radio waves which caused the filament of the lamp to glow. Even if the bulb is held in the hand, it will glow when put in the field of a properly adjusted oscillator. I also know of a specially constructed electric bulb for magicians, that produces the same effect. It contains a smaller bulb and a tiny battery, and it is capable of giving a light equal to that of a twenty-five-watt lamp. Of course, the bulb is frosted. They can be bought at any good ma-

gician's supply house. What J.Y. saw might have been one of these, provided there were no concealed wires, as he seems certain there were not.—D.C.S., Chicago, Ill.

These Spheres Will Make Your Head Go 'Round

WE KNOW that a group of adjacent, elastic circles, pressed laterally together, would become hexagons. However, let us assume we have a group of adjacent spheres, such as a mass of soap bubbles. Let these be crowded into a container so that the spaces that were present before are all taken up by pressure. Now, what is the shape of the erstwhile spheres at the center of the mass? How many sides have they, and what is the shape of the sides?—W.E.M., St. Charles, Mo.



Here's Where the Post Office Loses Some Business

DURING the recent Christmas season, I was reminded of your article "Can We Read Each Other's Minds?" when I read in the newspapers how a Canadian telepathy fan had sent out his seasonal greetings by thought transference. It seems that he just concentrated his mind for a few minutes on each friend that he wanted to wish a Merry Christmas, and trusted telepathy to do the rest. Sounds like a good idea, and how it would lighten the postman's holiday mail sack! I'm thinking of trying it out myself on St. Valentine's Day. Saves stamps, and if you get in a jam you can always claim that the wires were crossed.—R.A., Walla Walla, Wash.

He Takes His Car Troubles to the Model Garage

WHITTLING out the flintlock pistol for which you published plans was a lot of fun. I have a chemical laboratory, and always enjoy Raymond B. Wailes's experiments. But what I really started out to tell you is that Gus Wilson is darn good. Not long ago, as I was about to leave my house for work, my car wouldn't start. I fussed and fumed and tinkered with it. There were several friends waiting to ride to work with me. They were full of ideas, too. But they didn't help at all. Finally, I remembered Gus. I found the answer to my car's troubles first crack out of the box in (Continued on page 8)

THANKS, GUS!



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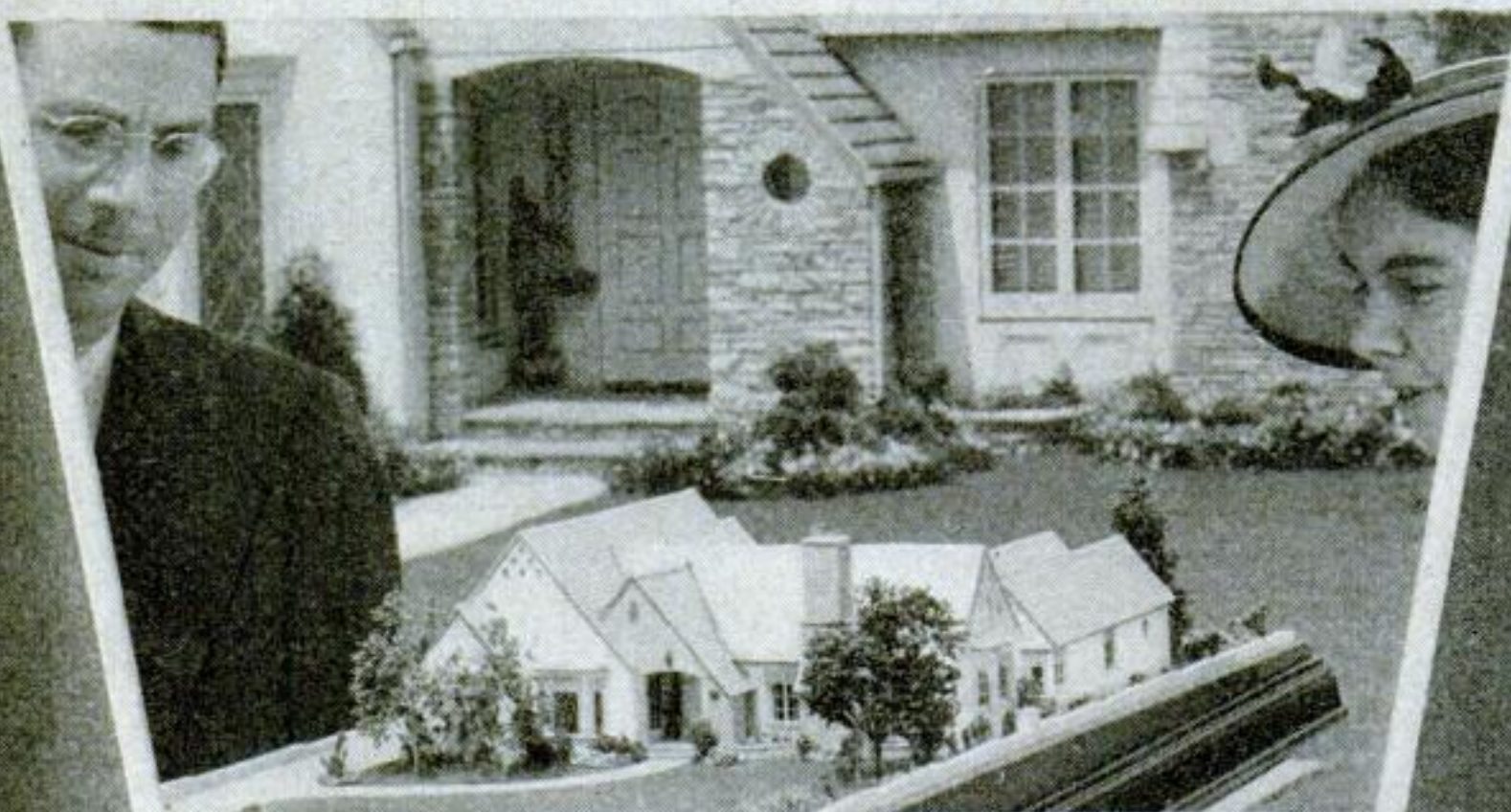
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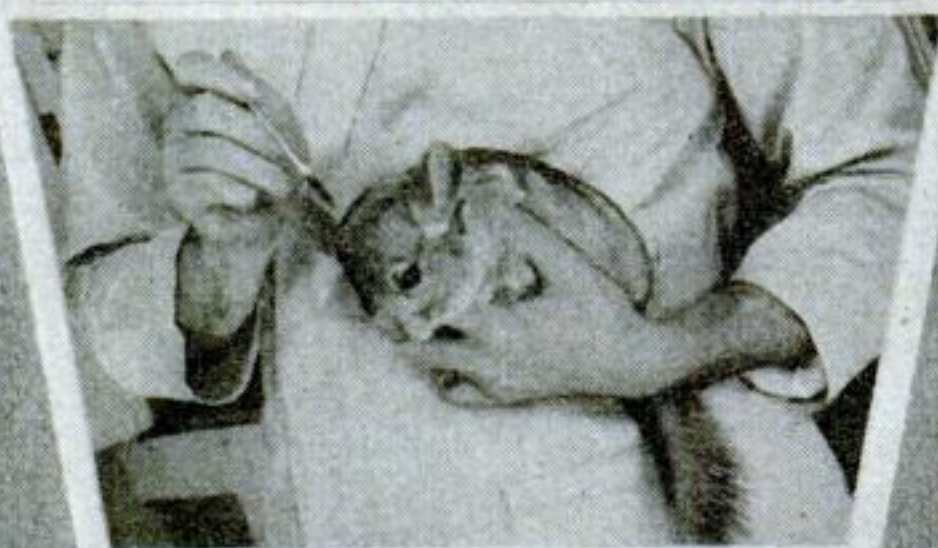
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A Paramount Picture

(Continued from page 6)

the October 1937 issue. Now I have the utmost faith in Gus. I have been reading your magazine for fourteen years, and still get the same thrill as the day I first discovered it.—G.R.N., Chicago, Ill.

Turkey Lover Holds Out for His Drumstick

SINCE WHEN was it an accepted fact that turkeys should have more white meat and less dark? On page 48 of your February issue there is an article that begins: "More white meat on turkeys is one of the purposes of scientific breeding methods developed by experts. . . ." Experts, hey? Well, they may be experts in some things, but they certainly are not experts in culinary tastes! For my part, I'll stick to the good old-fashion turkey that hasn't been turned into a lily-white imitation of its former bi-color, savory self. And if the day ever comes when turkeys have only one kind of meat, particularly if it's white, I'll see to it that nothing but duck is served at our table—that's all dark meat. Just think what Thanksgiving or Christmas dinner would be like if the turkey carver couldn't, as he brandished his carving knife and fork over a succulent roast turkey, ask the assembled, hungry family, in tones vibrant with anticipated pleasure, "Well folks, what'll it be? White meat or dark?"—J.H.T., Providence, R. I.

WE WANT TURKEYS WITH MORE DRUMSTICKS!



Wants Drawings of Coast Guard Ship

HAS any reader any information or drawings on the Coast Guard ship, *John B. Lane*? I understand that she was taken from smugglers by the government, refitted, and sent to the Mediterranean. She was a sailing ship, and had a small cannon set right up in the bow, and the forward rigging had to be struck every time the cannon was used. Later she was rerigged to overcome this difficulty. She was of interesting original design, and I would appreciate it very much if anyone could furnish me with as much information as possible about her.—A.M., East Boston, Mass.

He Got a Kick out of That Football Teaser

WORKING OUT the problem dealing with "footballistics," in the December issue, interested me very much. Neglecting air resistance, the trajectory of the football must have followed a standard parabola. By knowing two points on the parabola and their relationship, the maximum ordinate which occurs at the center of the trajectory can be found by solving simultaneous equations deduced from the facts given. For this value I got 20.9

GOSH, TRAJECTORY, PARABOLA, ORDINATE, MAYBE I OUGHT TO SEE A DOCTOR!



(Continued on page 9)

Our Readers Say

(Continued from page 8)

feet, which is the height that the ball must have reached to graze the bar and fall ten yards beyond the goal. Does anyone get a different result?—J.F.S., Attica, N. Y.

We'll Bet His Calculations Were Longer than His Letter

IN REGARD to the problem by H.B.H., of Philadelphia, in the January issue, concerning the oblique triangle, I calculated the unknown side and found it to be 8.678326 inches in length.—W.B., Chicago, Ill.

Mechanical Hitch-Hiker Is Taken for a Ride

IT IS a great relief to see, on page 42 of your February issue, that something has been done at last to lighten the terrific burden of the hitch-hiker. As a salesman, I do a lot of driving around the country, and I have been touched—in more ways than one—by these hard-working tourists. For an able-bodied young man, mooching across the country to see a football game or visit his grandmother, to be forced to stand on his feet for minutes at a time and wiggle his wrist at passing motorists, is a grave social injustice. As often as not, when some unworthy driver consents to stop, the hitch-hiker will find that the car does not provide the speed and comfort to which he is accustomed. I had one fellow climb into my flivver, plunk his muddy shoes on the dash, and sneer, "The last ride I got was in a Lincoln!" Your mechanical ride thumper is a step in the right direction, but the hiker still has to sit up while waiting for his lift. Then, too, the wire has to be pulled to jerk the mechanical thumb. Shucks, that's as much trouble as saying "Thank you!"—D.R., Chicago, Ill.

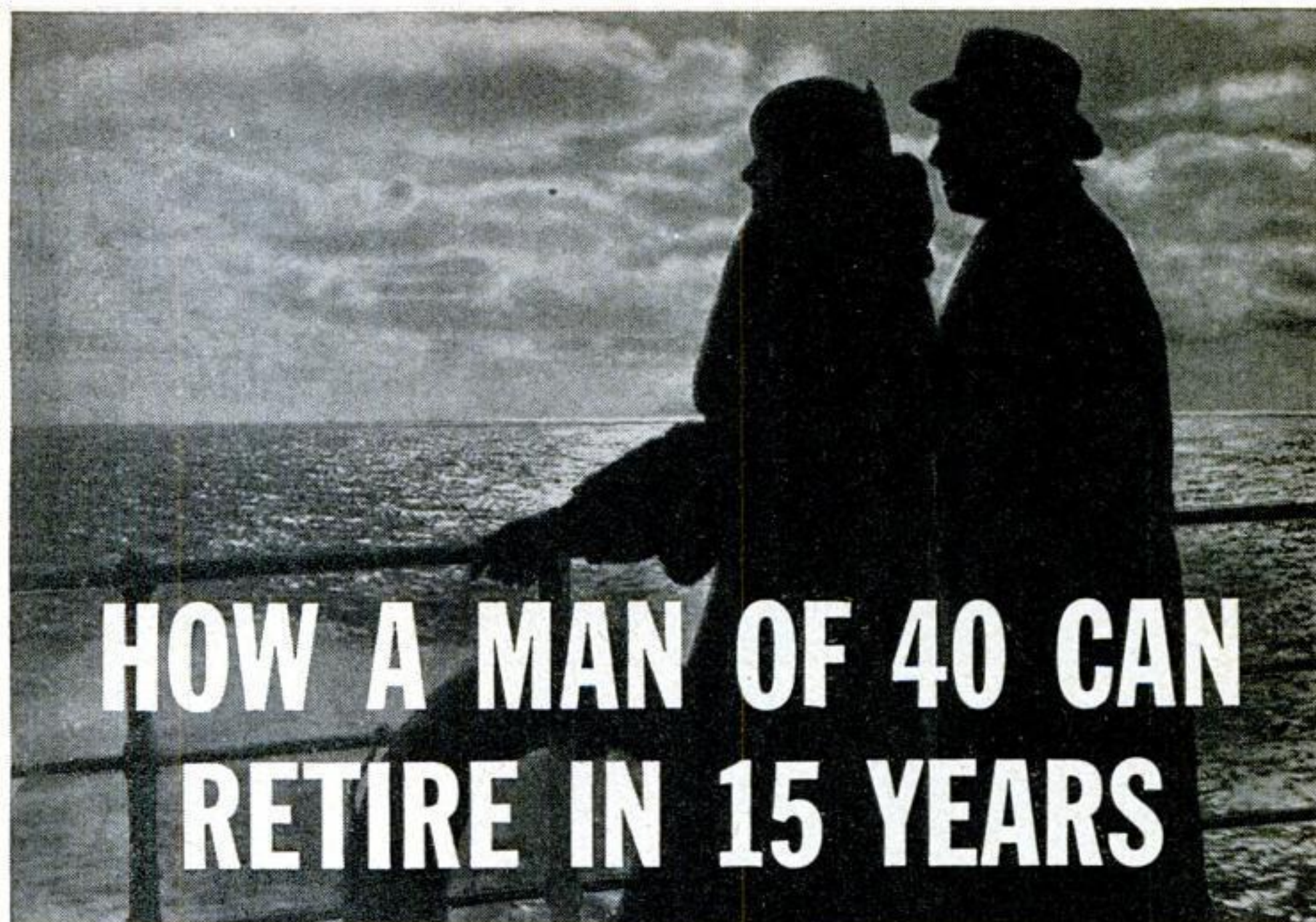
GOT TA BE A ROLL WITH CHAUFFEUR. RADIO, 'N EVERYTHING!



Monkey Business Brought Him to the End of His Rope

IF ANYONE else has the patience to stick to that monkey problem long enough, he'll probably come to the same conclusion I did, namely, that the long sentence near the end, boiled down to simple language, means that the mother monkey's age equals two times one half of nine times the monkey's age, or $9x$.—I let x equal the monkey's age, and y its mother's.—You can really throw out two clauses in that age relationship, because one clause multiplies the monkey's age by two, at the same time the other divides the mother monkey's age by two. Setting up two equations with the unknowns, it is then possible to solve and substitute, getting .4 years for the monkey's age and 3.6 years for its mother's age, the latter also being the figure for the weight of the monkey in pounds. Since the weight of the rope is half again as much as the difference in weights of the empty pan and the one containing the monkey, you multiply 1.5 by 3.6, get-

(Continued on page 10)



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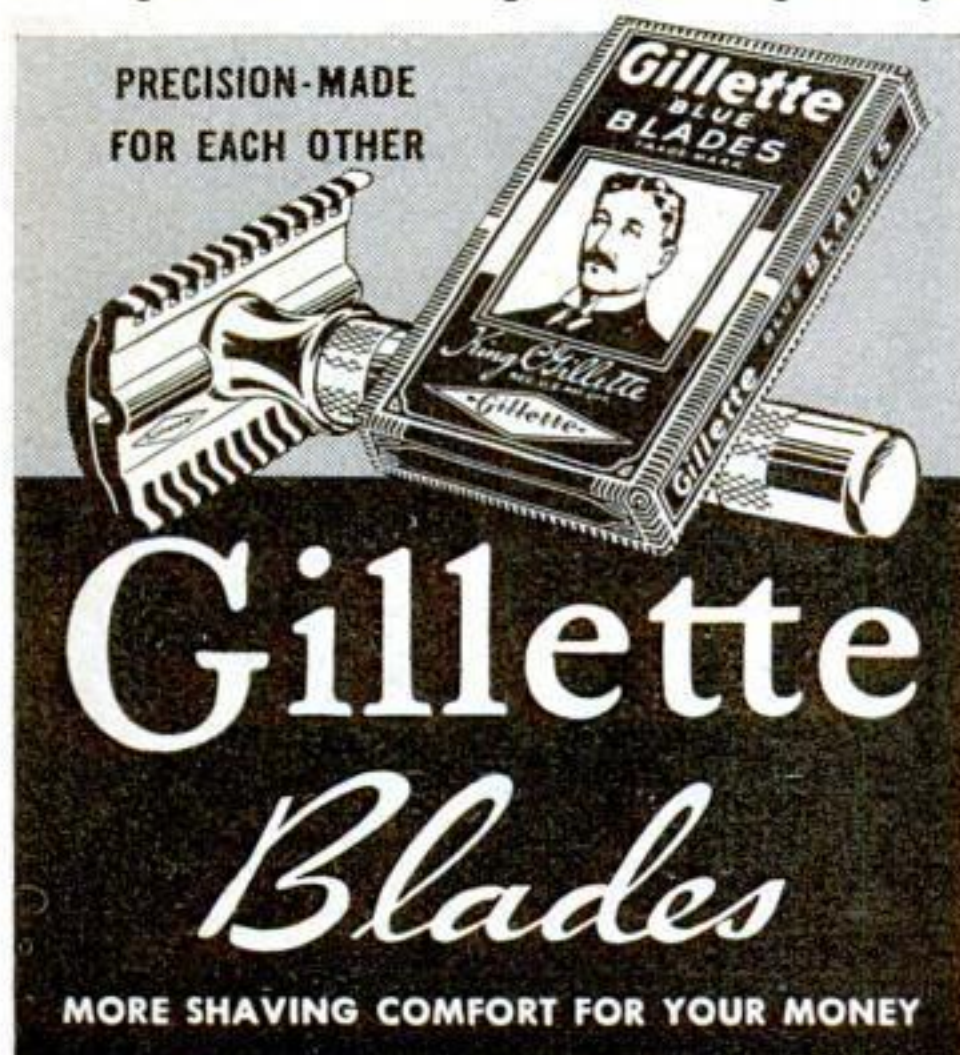
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(Continued from page 9)

ting 5.4 pounds, or 86.4 ounces, for the weight of the rope. But the rope weighs four ounces to the foot. Hence, the rope is 21.6 feet from end to end.—F.W.V.D., Jr., Towaco, N. J.

He Wants a Car that Won't Run on Alcohol

IN DESIGNING all these various gadgets to test automobile drivers for drunkenness, it seems that the nation's police departments are putting the cart before the horse. Why not perfect some sort of odormeter that could be wired into the ignition system of every car? Being sensitive to the alcoholic fumes from a tippler's breath it would automatically open the ignition circuit whenever a merry-maker climbed into the driver's seat, and make it impossible to start the car. I'll admit the system might be hard on the ladies who like to use strong perfumes, but then I'm in favor of that too.—L.D.C., Chicago, Ill.

HOW ABOUT A TEST
FOR COPS' FITNESS
TO TEST US?



He Liked the Article on One-Piece Rails

ONE-PIECE railroads, described in your February article, certainly are a big step forward. Your pictures told the story in detail and in an interesting manner. I confess that I am puzzled by the statement that, once laid, the rails cease to expand and contract with changes in temperature. It seems as though there would be some danger of them buckling in hot weather and separating in very cold weather. Time will tell. What I would like to know is how one-piece rails can be put down on a road bed where no track has existed before. There wouldn't be any rails there for the track-laying train to ride over. Has any system been devised to make the laying of new one-piece rails possible?—M.A.L., East Orange, N. J.

Model-Boat Builder's Tribute to Capt. E. Armitage McCann

MODEL-BOAT builders lost a real friend in the death of Capt. E. Armitage McCann, to whom we turned when our boat problems became too difficult. Although he is no longer with us, his training, his drawings, his models live on forever.—I.P., Hamilton, Ohio.

It Might Be Rough on Bridgework and Fillings

IN YOUR December issue, page 59, you pictured a girl getting her hair waved with curlers without wires, the curlers first being heated in a rack equipped for the purpose. Wouldn't it be a good idea to use iron curlers, and heat them by means of a high-frequency electric current from a coil designed in the shape of a small booth, inside of which the customer would sit?—E.N.P., Buhl, Minn.

MAYBE THE ELECTRIC
CHAIR WOULD BE
LESS PAINFUL!



THE TRUTH THAT WAS DAMNED

Man dared become masterful and independent! Centuries ago he began to probe the mysteries of the universe, to disclose the hidden truths of nature. Astounding results were achieved—miracles, some declared them. The conditions which enslaved men and women—misfortune, disease and despair—were conquered. This wealth of knowledge was accumulated in vast temples and seats of learning available to all who sought it. This growing power and knowledge of the masses was a challenge to selfish rulers and corrupt priesthods. Alexandria was ordered burned, Tripoli destroyed. The rare knowledge was damned, seized and burned.

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BAND INSTRUMENTS

Seeds Taken Aloft May Give New Fruits

FUTURE ascents into the stratosphere may result in the development of new varieties of fruits and vegetables, according to the theory of Milwaukee, Wis., engineers. Exposure of fruit seeds to X rays, it is pointed out, has resulted in definite changes in the type of fruit grown from them. If balloonists planning flights into the stratosphere would take along samples of seeds, it would be possible, the engineers suggest, to determine whether concentration of cosmic-ray radiation in the upper atmosphere will also affect seeds and make them produce varieties of fruits and vegetables.

Novel Plastic Iron Is Soft as Lead

PLASTIC iron that is as soft and pliable as lead has been developed following many years of experimentation by Dr. Hans Vogt, a German physicist. Lighter and more economical to produce than lead, the new metal can serve many of the purposes for which lead is now used. The spongy metal is made by solidifying powdered iron at temperatures above 2,000 degrees F. in an atmosphere of hydrogen that prevents the formation of oxides. Tiny cavities that appear in the finished product give it its plastic properties.

Electric-Light Switch Makes No Noise

ELECTRIC switches that make no sound when they are snapped on and off to light or turn off lamps are a new development reported by General Electric research engineers. The new switch has no moving parts, electrical contacts being made and broken by means of a flow of mercury within the unit. In two years of laboratory tests, the device was operated more than 65,000,000 times without failure.

Automatic Airplanes Will Fly Themselves

COMPLETELY automatic airplanes, operating from take-off to landing without the help of human hands, may make their appearance in the future, according to the belief of Capt. George V. Holloman, of the U. S. Army Air Corps. Captain Holloman recently told the Society of Automotive Engineers that, with the accomplishment of automatic, radio-directed airplane landings made a fact by Army tests, it is well within the realm of reason to visualize an airplane taking off from an airport, flying directly to its destination at safe altitudes, and landing, the whole being accomplished automatically by means of mechanical devices to operate the various controls. The crew of such a ship would only be required to observe the instruments and equipment to see that they were functioning properly.

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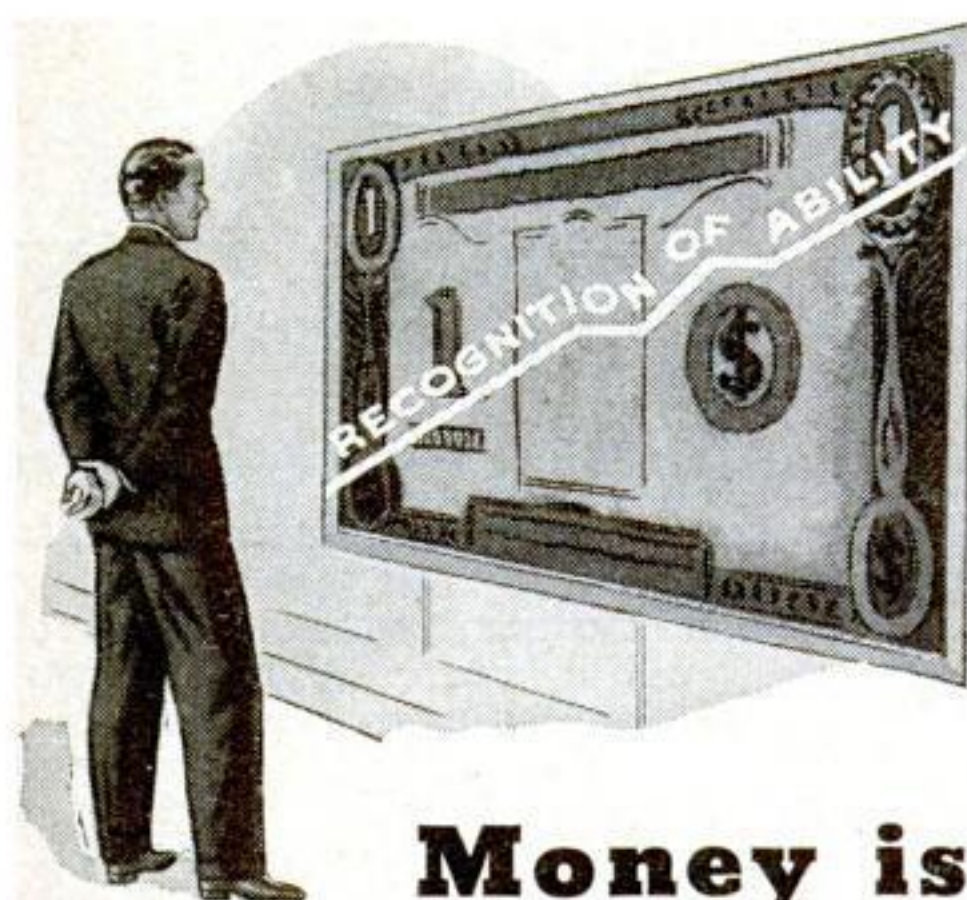
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MASTERED ELECTRICITY IN HIS SPARE TIME

MY HOME was on a small farm where there was little or no opportunity for an education. I worked at whatever I could get to make a little money, and at eighteen years of age I was working in the mines. At this time I met a young lady school-teacher who became interested in me and coached me until I completed eighth-grade arithmetic. I later married this same girl.

We then moved to a near-by town, where I worked at the _____ Co. This was in 1920. It was at this time that I took a course from _____ Schools in electrical engineering. Work became very scarce, so they cut the wages until I was making only twenty-five cents an hour. I was later laid off altogether.

It was then that the representative from the _____ Schools stepped in and got me a job with a company that manufactures gas en-

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Secrets of Success

gines. My study helped me a great deal and I stayed there about two years.

In 1923, I read that the ——— Co. was putting in a new plant at another town, and I decided to go there and try to get in, as I knew there would be much experience there that would be a big help to me. I have been here now for fourteen years. I have made good money and the work has been very interesting. I'm sure that if I had not studied I would never have been able to hold my job. I completed my course in 1929, and then took a course in practical psychology from the ——— School and completed it.

In 1931, work began to slacken and I took a course in cost accounting from ——— Schools, which I felt would be of much use to me if I should get a promotion. I worked many nights on this until three o'clock in the morning. Some wondered at my taking this, but it made me see the company in an entirely different light. Before this I was with the gang, but now I realize the load of the man above me and feel I should give a day's work when I get paid for it. I have the second course almost completed. I had my money invested in stocks, and of course it slipped during the depression, but instead of worrying about it I studied and kept up my courage. It also gave my wife hope, and she held right on.

I did not realize what I had achieved by the upward pull until I went back to the mining town where I had worked in the mines and talked to some of the men who had just let themselves drift until I felt they had drifted to almost the lowest stage of civilization. They were on relief and were making no effort whatever to make any change.

Keeping forging ahead has not only meant mental and spiritual uplift, but also material. I have a new car, my home nicely furnished, good clothes for myself and family, and a nice bank account.

I am a member of the First Methodist Church and the Masonic lodge. I merely mention this to show I have done other things beside my work, as I feel we owe a debt to others and feel we can pay this best by joining others who are interested in the same cause.

As yet, I have not had much promotion at my work, but feel I would have been laid off if I had not had the upward vision. Others may feel I have not achieved anything, but I do not regret spending the money or time as I know I am prepared, and I will carry on until the goal has been reached.

ACCOMPLISHMENT IS WORTH THE MIDNIGHT OIL

THIS is not the beginning of a get-rich-quick story, but I do think it portrays a fast advancement.

I graduated from high school in 1931. I was living in Iowa, an agricultural state. There was nothing for me to do but to go to work as a farm



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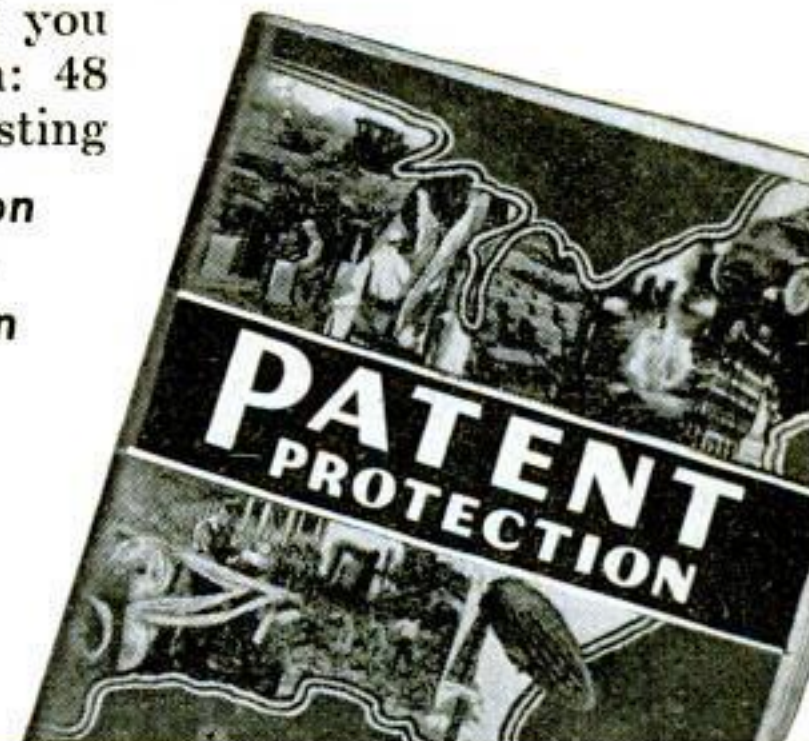
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Secrets of Success

hand. The depression was about at its worst at that time in Iowa. My parents didn't have money to send me to school. In other words, I had to shift for myself. I worked at farm work for four and a half years at a very small wage, working most every winter for my board and room.

I didn't want to make farm work my future. I always had a desire to be a mechanical draftsman. I didn't have enough money to go to school, and at the rate I was earning, it didn't look to me as though I ever would. I often thought of correspondence courses. I knew that with the long days on the farm it was useless for me to attempt it. In order to study I had to find work with shorter hours.

In January 1935, I decided to try my luck in getting into a factory. I had relatives living in Wisconsin. I was there only a week when I secured a position with the ——— Co., as a helper on the erecting floor. I worked there until the middle of May, when I was laid off. All the factories were laying men off then, so it was impossible to get in anywhere else. They promised to call me back as soon as they got the work. I couldn't sit and wait. I got work painting a house.

Shortly after starting work in January, I enrolled in night school and took blueprint reading and mechanical drawing. Night school ended the first of March. I had become so interested in the work that I didn't want to stop. So I enrolled with the ——— School for a correspondence course in mechanical drafting. I studied hard and burned a lot of midnight oil.

On July 8, the ——— Co. called me back to work, this time putting me in as pattern clerk. I worked in that department until December 1, 1936, with one advancement. Then I was transferred to the drafting room. I had only about half finished my course with ——— School.

I haven't reached my goal yet, but I'm well on my way. I owe it all to the course in correspondence. It takes lots of hard work, but the accomplishment in the end is well worth those few evenings of every week that are spent at home studying.

Correspondence study is one of the greatest opportunities there is for the working man or person with limited means to get ahead.

—R. M., Beloit, Wis.

SEAMAN BECOMES MATE BY HOME STUDY

LATELY, I have been reading the letters appearing in your column, "Secrets of Success," which have prompted me to write of the benefits I received from my own home-study course. I had been employed by the U. S. Engineer Department for twelve years on small harbor and coast boats at a moderate salary. Although getting several small salary raises, I considered my progress insufficient, and decided something

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Secrets of Success

should be done. I had thought of enrolling in a correspondence course, but could not make up my mind until one day, while reading some testimonials of the _____ Schools, I noted the signature affixed to one of them was that of a man holding a high position in the same department where I was employed.

It was then that I decided on my plan, and I immediately enrolled in a course in ocean navigation with the _____ Schools. Before fully completing the course, I took an examination for and obtained a chief mate's license for coastwise vessels of unlimited tonnage. I immediately secured a position in the same department as chief officer, at a salary increase of \$400 a year.

I feel certain that my correspondence course helped me greatly in passing my examination, and can truly recommend such a course to other seamen who are trying to advance their positions.

—B. O. B., Galveston, Tex.

Flying Infantrymen Picked for Lightness

COMPANIES of lightweight infantrymen are being organized by British military authorities for aviation purposes. Men forming the new units will weigh less than 112 pounds, and will be carried on transport planes whenever a small expeditionary force is required on short notice. By creating these lightweight units, authorities estimate that planes can carry a third more soldiers on each trip. Receiving higher pay than ordinary infantrymen, the 100-pound soldiers will be stationed in Egypt and in India, according to reports.

Bumper for Goats Prevents Injuries

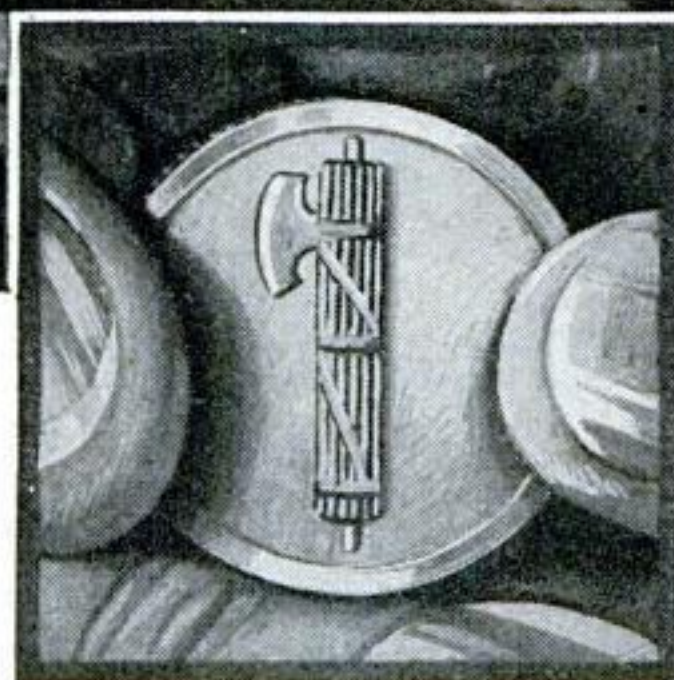
A BUMPER that fastens onto the horns of a ram has been invented by James A. Caldwell, of San Antonio, Texas, to prevent a butting goat from injuring either itself or other animals. Made of reinforced rubber, the device consists of a bumper plate that extends along the forehead of the ram and is held in place by means of chains that lock onto its horns.

New Carpet Sweeper Is Easily Cleaned

CARPET sweepers that come almost completely apart for quick cleaning are being designed as a household aid. The entire top of the sweeper is hinged, and lifts up after a catch has been released. The rotary brush may then be lifted out. A comb which collects pieces of string and hair that cling to the brush also is easily detached, and sweepings in the dust compartment are shaken through the bottom for cleaning the apparatus.

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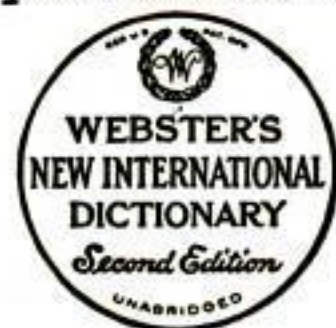
"IN ANCIENT ROME this bundle of rods surrounding an ax was carried before a magistrate as his badge of authority. It symbolized his power to enforce the law through flogging or beheading. In Fascist Italy, the *Fasces* now stands for the unification of all the nation's forces into a single powerful authority."

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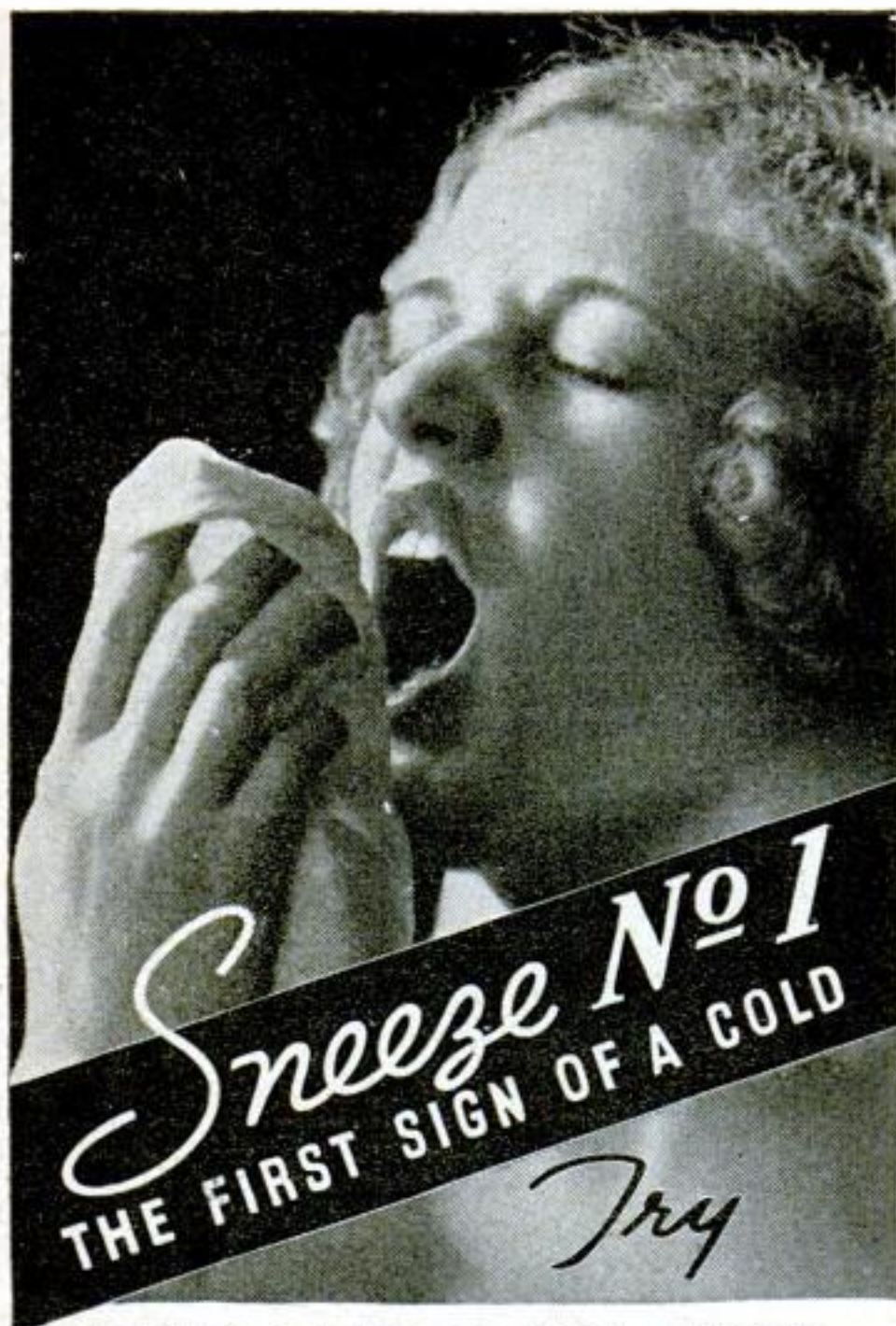
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This two-way telephone unit, installed in the kitchen or hall, is connected with another instrument set into the outside door

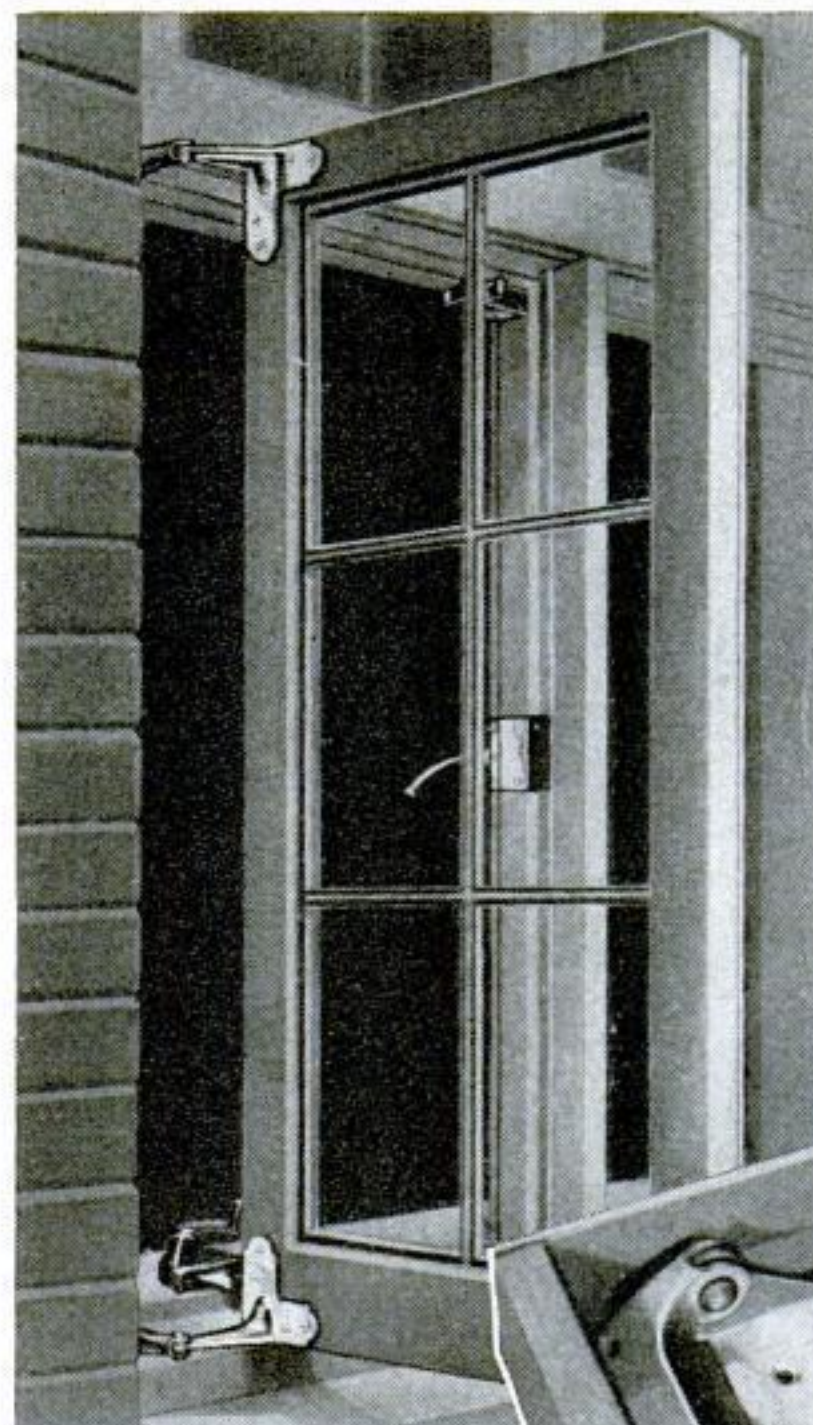


Handy Aids

FOR HOME MECHANICS

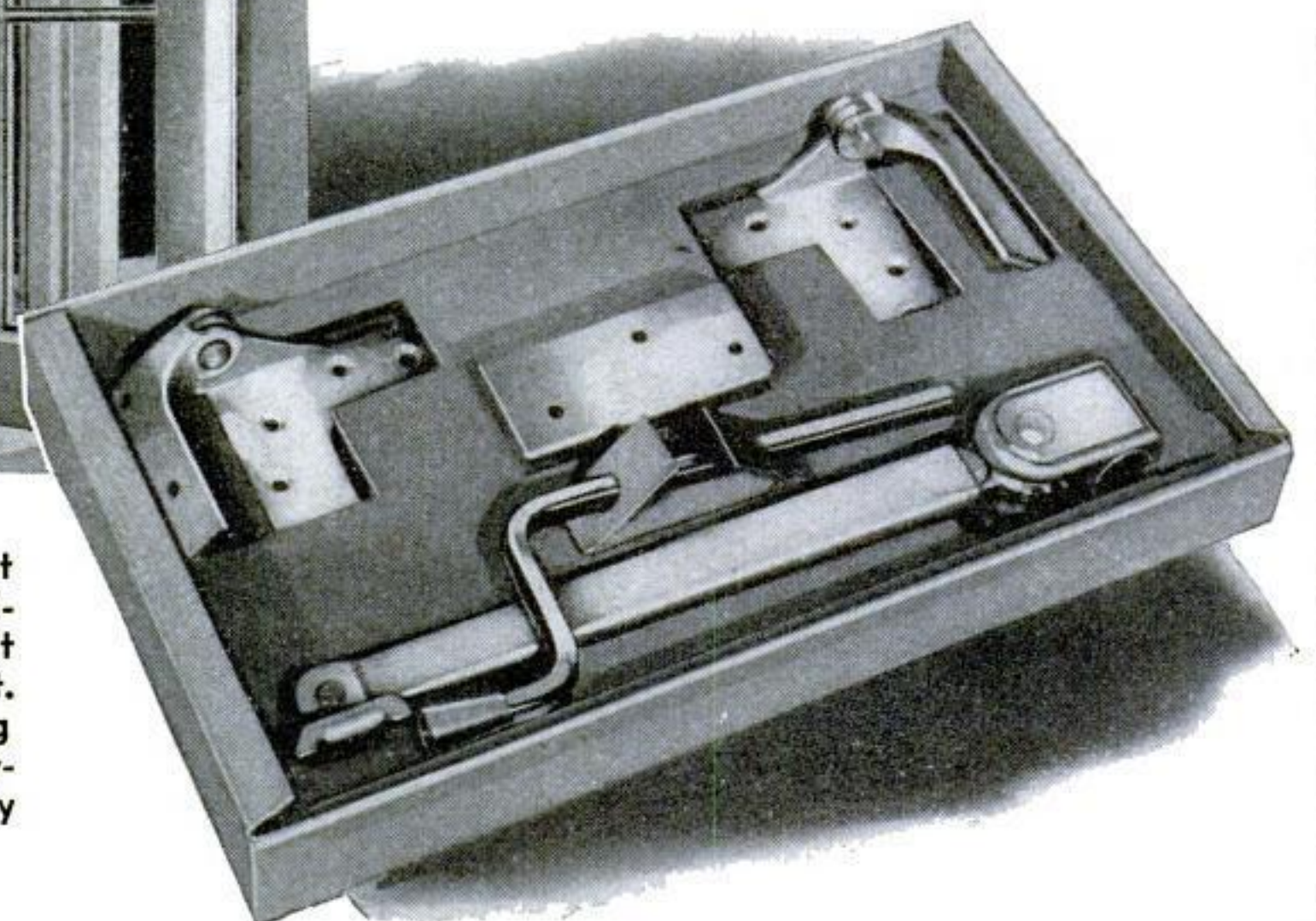
AS A protection against intruders who might force their way into a house when the door is opened in response to a ring of the doorbell, a complete two-way telephone unit is now commercially available to the home owner. One end of the system has a telephone mounted on a wall case in

the kitchen or hall of the home. The other end terminates in a combination microphone and loudspeaker set into the jamb of the front or back doorway. By using the system, a housewife can learn the identity of the person at the door before releasing the lock.



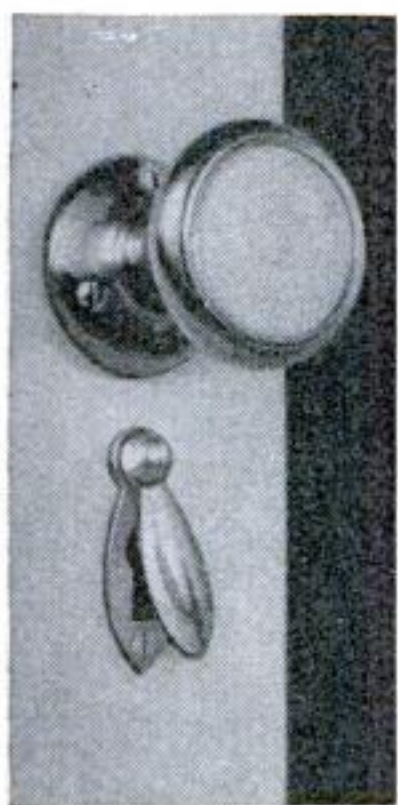
Kit Contains Hardware for Casement Window

HARDWARE pieces for installing and operating a wood casement window are now sold in a matched set. The kit includes an automatic top-holder for pulling the window into the frame at the top of the sash, a pair of corner-reinforcing hinges, and a geared arm with which the casement may be opened or closed even if a screen is in place. The hardware is shown boxed below, and, at the left, installed in a window.



Wooden casement fitted with hardware from the kit seen at the right. The matching pieces include everything necessary

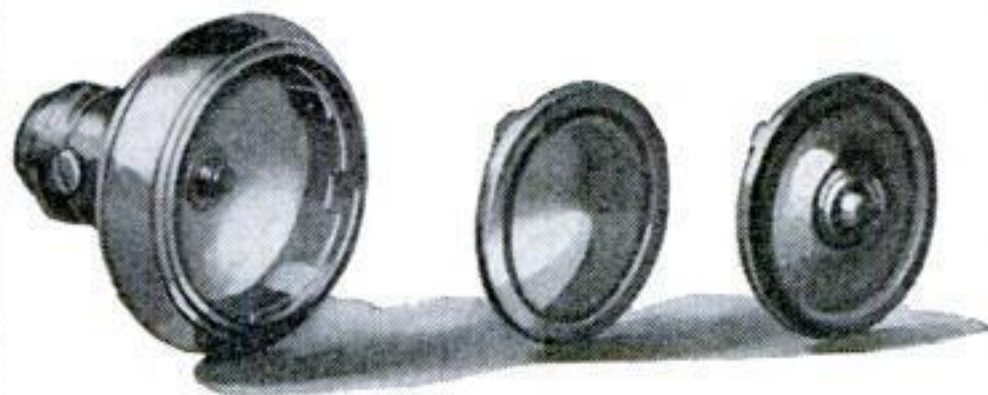
Novel Door Knob Has Interchangeable Faces



Four face designs are available for this new door knob

A NEW type of door knob having interchangeable face designs is now available to home owners. The knob body, made of brass, is of standard shank cross-section, which will accommodate tops in any one of four different patterns. By having their homes fitted with this type of door knob, householders can at any time change the style

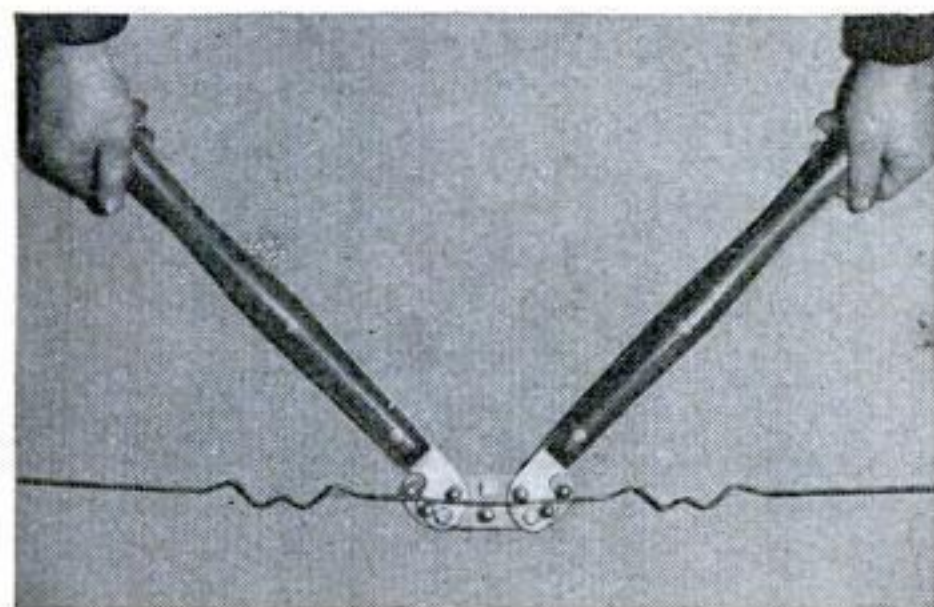
of the hardware to suit new decorative room treatment, without complete replacement of the knobs. Hardware dealers can stock extra knobs in various patterns. The photograph below shows the standard-size shank with two of the interchangeable tops, while above at the left is the new knob assembly as it appears when installed.



Spring clips inside the head of the knob hold the interchangeable designs tightly in place

Hand Tool Tightens Sagging Wire Fences

SAGGING wire fences can be tightened with a lightweight tool just placed on the market. About the size and weight of a pair of hedge shears, the tool is stretched out to its widest position and snapped onto a loose wire. As the handles are brought together by the operator, a crimp is made in the wire by the toggle action of pins located at the head of the tool. Single wires of all sizes commonly used by contractors in building fences can be crimped and shortened with the tool quickly and easily.



How the plierlike tool is used to put crimps in a sagging fence wire to take up the slack

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| <input type="checkbox"/> Radio | <input type="checkbox"/> Highway Engineer | <input type="checkbox"/> Steam Electric Engineer | <input type="checkbox"/> Agriculture |
| <input type="checkbox"/> Refrigeration | <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Marine Engineer | <input type="checkbox"/> Navigation |
| | <input type="checkbox"/> Surveying and Mapping | | |

BUSINESS TRAINING COURSES

- | | | | |
|--|---|--|---|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> First Year College Subjects | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Secretarial Work | <input type="checkbox"/> Business Correspondence | <input type="checkbox"/> College Preparatory |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Spanish | <input type="checkbox"/> Stenography and Typing | <input type="checkbox"/> Illustrating |
| <input type="checkbox"/> Accountancy | <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Civil Service | <input type="checkbox"/> Mail Carrier |
| <input type="checkbox"/> Cost Accountant | <input type="checkbox"/> Service Station Salesmanship | <input type="checkbox"/> Railway Mail Clerk | <input type="checkbox"/> Cartooning |
| <input type="checkbox"/> C. P. Accountant | <input type="checkbox"/> Advertising | <input type="checkbox"/> Grade School Subjects | <input type="checkbox"/> Lettering Show Cards |
| | | | <input type="checkbox"/> Signs |

DOMESTIC SCIENCE COURSES

- | | |
|---|--|
| <input type="checkbox"/> Professional Dressmaking and Designing | <input type="checkbox"/> Tea Room and Cafeteria Management, Catering |
| <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Millinery |
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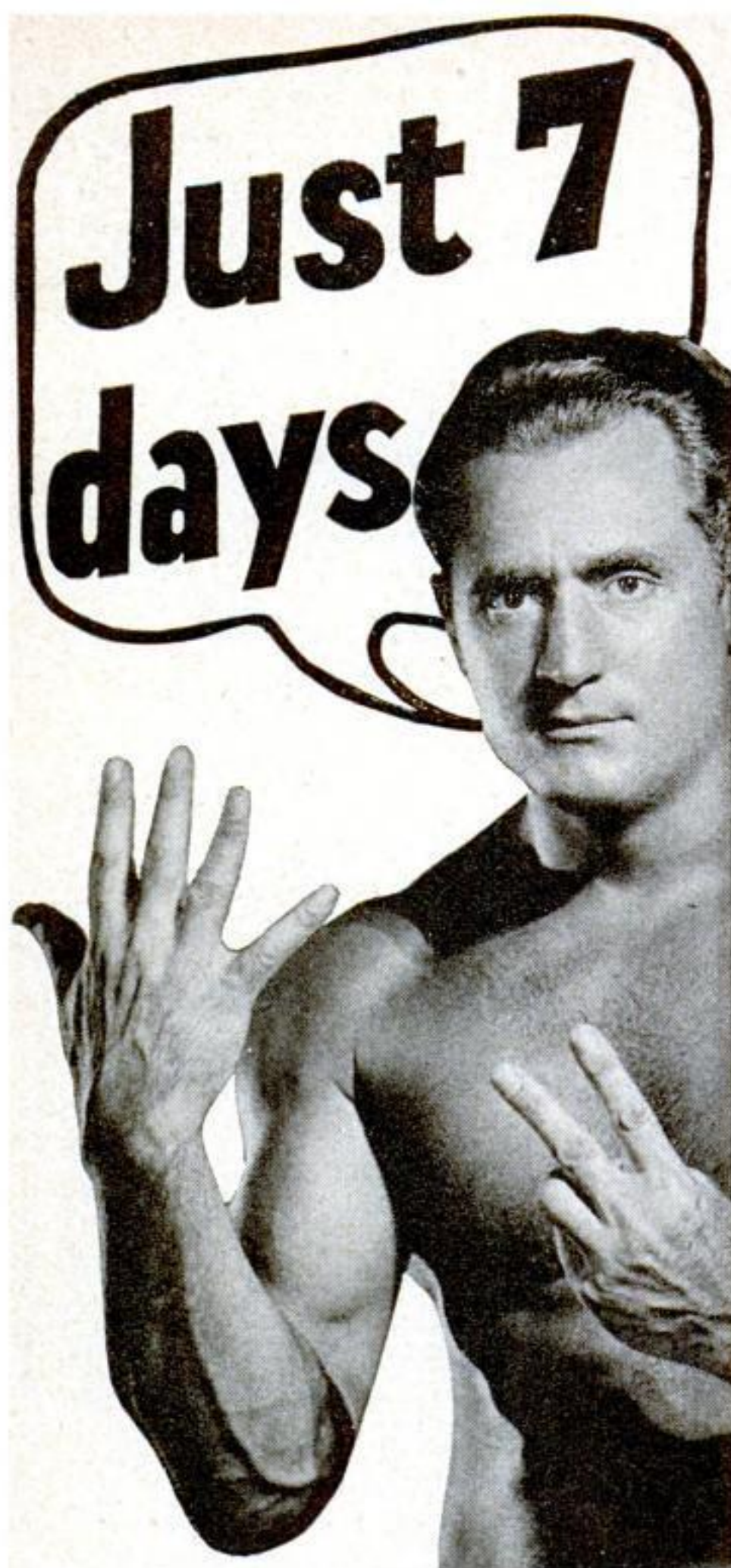
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This valuable cup stands about 14 inches high on a black mahogany base. I will award it to my pupil who makes the most improvement in his development within the next three months.



Cut from flexible strips of steel, these Venetian blinds can be bent out of shape safely

Steel Venetian Blinds Are Flexible

VENETIAN window blinds cut from flexible strips of steel instead of the conventional wood are now available to home owners. Durable, and easy to clean, the steel blinds are painted in a variety of shades to harmonize with interior woodwork or wall coloring. Because they are flexible, the blinds spring back to their original position if they are temporarily bent, twisted, or pulled out of their normal shape.

Questions FROM HOME OWNERS

Q.—EACH spring our front lawn becomes infested with moles. When spring comes around this year I want to be prepared. What is the simplest and cheapest way to get rid of these pests? —C. D. C., Raleigh, N. C.

A.—VAPOR from carbon disulphide, a chemical readily available, will do the job. Fill a garden spray with the chemical, and pump the liquid into the mole runs. The heavy fumes that form will spread to the nest and destroy the rodents.

Reflector for Radiator

T. Y. B., DENVER, COLO. One type of reflector for use back of a radiator to throw heat out into a room can be made by coating a rectangle of corrugated cardboard with aluminum paint. Be sure and use paint that will dry with a bright, shiny surface.

Oilcloth Stops Rug Skid

R. R., TACOMA, WASH. To prevent rugs from slipping on a polished floor, sew oilcloth to the under side of the rug so that the shiny side faces the floor.

Keeps Cellar Floor Dry

C. D. F., HOLYOKE, MASS. Seepage from the subsoil can be prevented if

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Even if you now are only 18, 25 or 30, you should *look ahead*—begin training TODAY for the job you want at 50. Training helps you to be independent—self-supporting. It helps you to enjoy associations that are denied the untrained man. Training helps you to increase your earning power more QUICKLY—and by so doing to offer members of your family advantages far in excess of what you could give them as an untrained man. Train and enjoy PROGRESS—CONTENTMENT—INDEPENDENCE.

American School, Dept. DD-346, Drexel Ave. at 58th St., Chicago

(Continued from page 18)

you seal the concrete floor of your cellar. Make up a generous quantity of a mixture of water glass and water, in the proportion of one pint of water glass to four of water. Spread this over the floor with an old broom and allow it to dry. The process should then be repeated in a day or so.

Deposit from Oil Burner

Q.—WHEN there is a layer of oily smudge on the woodwork and window sills, is it the fault of dirty oil or of the oil burner itself?—V. B., Dayton, Ohio.

A.—THE deposit is probably due to incomplete or faulty combustion of the oil in the burner. Call the company from which you bought the burner and have a man come to inspect and adjust it.

Bricks Stop Termites

N. D. R., COLUMBIA, S.C. Replacing the wood on top of cellar foundations with bricks or concrete and metal will help in keeping down the spread of termites into the house.

Waterproofing Cement-Block Walls

Q.—IN WATERPROOFING the cement-block walls of my garage, should I apply the waterproofing material to the inside or the outside surface?—K. L., Salt Lake City, Utah.

A.—A WATERPROOF cement paint ap-

plied to the outside of the walls should prevent the dampness from coming through.

Comparative Cost of Oil and Coal

T. M. K., PITTSBURGH, PA. In attempting to compare the cost of heating a home with coal as compared with oil, you can figure that 145 gallons of oil is the approximate equivalent of a ton of coal in the amount of heat delivered by the two fuels.

Don't Insulate with Paper

R. D. A., WATERTOWN, N.Y. Old newspapers and sawdust laid between the floor beams in your attic may help to insulate it from the lower floor, but they will constitute a serious fire hazard. It is better to use one of the insulating materials on the market. If you plan to use the attic, the insulation should of course be placed between the rafters and on any existing side-wall surfaces.

Chemical Protects Silver

Q.—I HAVE heard that it is a good idea to keep several pieces of camphor in a silver-storage drawer. Is there anything to this point, and, if so, what good does the camphor do?—B. H., Hartford, Conn.

A.—ONE thing that the camphor might do is to absorb moisture and prevent tarnishing.



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How fast can an automobile take a highway curve without undue side slip or skidding? This information is determined automatically by a novel meter developed by Missouri state-highway engineers. On the basis of estimates recorded by the machine in practical tests on Missouri roads, warning signs have been made advising motorists at strategic points of the maximum safe speed at which they may drive their cars. C. W. Brown, chief engineer of the Missouri Highway Department, reports that the public is responding favorably to the new signs.

Typewriter Ribbon Has Only One Side Inked

INKED on only one side, a new typewriter ribbon devised by George W. Schaefer, of Quincy, Mass., reduces clogging of typewriters caused by pieces of ink-saturated dust and paper getting into the moving parts of a machine, and helps the operator keep his hands clean. The novel ribbon is installed in a typewriter or similar machine in such a way that the type strikes it on the clean side, pressing the ink on the other side onto the paper.

Chemical Improves Plywood's Quality

FIR plywood, treated chemically so that it is said to compare in beauty and durability with the more expensive hardwoods, has been placed on the market. The treatment consists of direct application by machinery of a chemical made of synthetic resins which waterproof, seal, and prime the pores of the wood. The product then will take any kind of finishing material such as paint, enamel, lacquer, oil, or water stains, without raising the grain, and without showing sharp contrasts between the soft and hard fibers. The treatment does not materially change the appearance of the substance. Although fir plywood has been used for building and decorating purposes in the past, the treatment is said to make possible its use in dry-wall construction, prefabricated houses, paneling, cabinet work, concrete forms, trailers, and railroad-car lining. Besides being moistureproof, it is resistant to wear, weather, decay, and mold.

New Bathroom Mirror Does Not Get Foggy

MOISTURE will not condense on a new bathroom mirror, designed by Manuel Somohano, of Mexico City, as a boon to shavers. The mirror contains an electrical heating unit that keeps the temperature of the glass above that of the room, so that vapor released into the bathroom air when the hot-water faucet is opened does not condense on the surface to blur it.

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Tank-Destroying Gun Has Five-Mile Range

CAPABLE of being set up for action in fifty seconds, a new 75-mm. howitzer recently tested by the U.S. Army is so small that it resembles a toy gun. Yet the howitzer will fire six high-explosive or shrapnel shells a minute and, because of its flexibility, it is expected to be one of the Army's most effective weapons against tanks. It is towed by a truck from which it can be quickly uncoupled. It has a range of more than five miles, and can be revolved through a forty-four-degree angle without shifting the gun trail.

Pressure in Roots Causes Sap to Flow

SMASHED to pieces by the pressure of sap in the roots of a tomato vine, a scientific apparatus devised by Dr. Philip Rodney White, of the Rockefeller Institute's Princeton, N.J., laboratory, proved definitely that sap flow in plants is caused by pressure below rather than by vacuum from above. Ever since scientists knew that sap flowed through vegetation from the roots, they have been puzzled by the cause of this flow. Frequent measurements of the pressure in roots tended to disprove the contention that this caused the flow, because no one recorded a pressure adequate to raise the liquid to the tops of tall trees. For this reason it was theorized that evaporation of the liquid saps near the tops of plants created a vacuum which lifted the liquids in a solid column. Dr. White's apparatus, consisting of a column of mercury confined in a glass tube, was attached to the living roots of a tomato vine. The mercury rose until it was recording a total pressure of 125 pounds a square inch. Then the tube broke. Dr. White explained that the reason former tests did not reveal the pressure was because they were made on dead or dying roots.

Ground Animal Bones Filter Drinking Water

GROUND animal bones may prove an efficient filter for removing the chemical fluorine from drinking water, according to a discovery of Prof. H. V. Smith, of the University of Arizona, Tucson. Fluorine, found in the water of reservoirs in the southern and western parts of the United States, causes mottling of the teeth of users in the localities affected. After preparation by a chemical process, the animal bones are ground and placed in a filter that is fitted in the intake pipes carrying water from the reservoir. The bones, according to Professor Smith, extract the fluorine as the water passes through. After considerable use, the ground bone loses its effectiveness as a filter and must be replaced with fresh material, or with used bone that has been revitalized and renewed by a chemical treatment.

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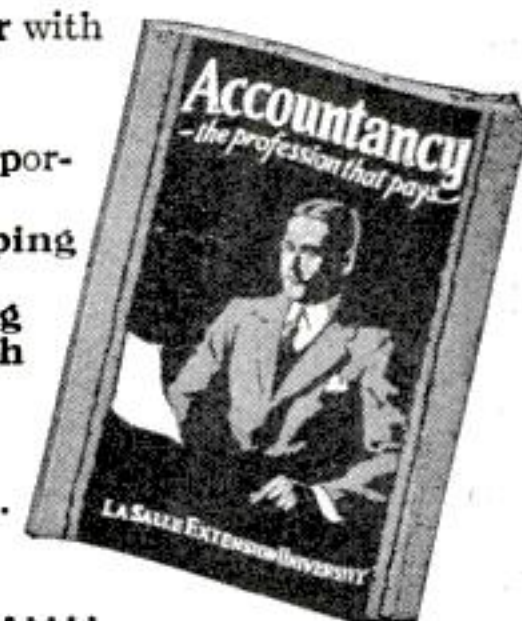
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30c a word for 3 consecutive issues, 35c a word for one issue. Minimum is 10 words. Each insertion is payable in advance. Copy for the April issue (appearing on the newsstands March 1st) must reach this office not later than January 30th, 1938.

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FREE! Each contestant whose drawing shows sufficient merit will receive a grading and advice as to whether he or she has, in our estimation, artistic talent worth developing.

Nowadays design and color play an important part in the sale of almost everything. Therefore the artist, who designs merchandise or illustrates advertising has become a real factor in modern industry. Machines can never displace him. Many Federal students, both men and girls who are now commercial designers or illustrators capable of earning from \$1,000 to \$5000 yearly have been trained by the Federal Course. Here's a splendid opportunity to test your talent. Read the rules and send your drawing to the address below.

RULES

This contest open only to amateurs, 16 years old or more. Professional commercial artists and Federal students are not eligible.

1. Make drawing of girl 5 inches high, on paper 6 inches high. Draw only the girl, not the lettering.
2. Use only pencil or pen.
3. No drawings will be returned.
4. Print your name, address, age and occupation on back of drawing.
5. All drawings must be received by Feb. 28th, 1938. Prizes will be awarded for drawings best in proportion and neatness by Federal Schools Faculty.

Submarine Gun Takes Sea-bottom Samples

LAYERS of the ocean floor 20,000 years old and showing six stages of deposits since the ice age, have been brought to the surface by means of a new submarine gun that fires a hollow projectile into the sea bottom. The projectile is recoverable, and the samples it cuts from the bottom are studied. Used over a wide area in the north Atlantic Ocean by geologists of the U. S. Department of the Interior and the Carnegie Institution's geophysical laboratory, the device brought to light many new facts concerning the glacial period of the earth's development. Among them it was revealed that there have been three glacial eras, separated by warmer interglacial intervals, since approximately 20,000 years ago.

Dead Leaves Make Cheap Fertilizer

FERTILIZER manufactured from the dead leaves gathered from streets and parks has been found economical and effective by the park department of Maplewood, N. J. The leaves, previously burned, now yield large quantities of good fertilizer annually. As the leaves are gathered in the fall, they are stacked in large piles and watered periodically. During the winter, the leaves are separated into smaller piles, mixed with a small amount of special fertilizer, and put through a carefully controlled watering process. By October, the outer foot and a half of each pile is sufficiently decomposed to make good non-acid fertilizer. It is placed in a shredder and then used for top dressing and lawn repairs. The remaining half-decomposed part is shredded and used for mulching shrubs, evergreens, and perennials in the city parks.

Ships May Get Power from Mercury Vapor

MERCURY instead of steam turbines to drive ocean liners may become practical if a boiler can be perfected for heating the liquid metal, according to William L. R. Emmet, honorary vice president of the Society of Naval Architects and Marine Engineers. Mr. Emmet, who was instrumental in the development of the electric drive for ships, and who invented the mercury-vapor boiler process for driving turbines, points out that although there are three such plants on land, none has been installed in a ship. If a good mercury boiler were developed, greater economy for ocean liners would be brought about, Emmet declares. A ship the size of the *Normandie* could save thirty-eight percent of its present fuel costs with a perfected mercury-vapor power plant, he estimates. The system utilizes vaporized mercury to drive a turbine, and then converts water into steam with the heat left in the mercury, in order to drive a second turbine on the same drive shaft.

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New Gas Is Detected High in Atmosphere

DISCOVERY of a hitherto unknown atmospheric gas existing from ten to twenty-five miles above the surface of the earth has been reported by Dr. Arthur Adel and Dr. C. O. Lampland, of the Lowell Observatory, Flagstaff, Ariz. The gas, nitrogen pentoxide, consists of molecules containing one atom of nitrogen and five atoms of oxygen, and is credited with being one of the rarest gases of the atmosphere, present only in the outer regions where the ultra-violet rays of the sun bring oxygen and nitrogen into combination with the aid of ozone. Because the rare gas filters out certain portions of the light from the sun, its presence was detected by use of a delicate spectrograph that showed a variation in the infra-red region of the spectrum.

Body Heat Of Animals Warms Farm Buildings

BARNs and other modern farm buildings need no other heating units than the livestock they house, provided the structures are properly insulated and ventilated, according to agricultural experts. Heat generated by the bodies of animals would make a properly built barn warm enough even in cold winter weather.

Dried Grass May Be Important Food Crop

DRIED grass, specially treated and prepared, may become one of the important food crops of the United States, according to Dr. George I. Christie, president of Ontario Agricultural College. Grass-eating by man would be a change no more startling than the development of the automobile from horse-and-buggy days to the present, Dr. Christie declared, adding that a man on his staff who suffered from stomach trouble has made a remarkable recovery from the ailment on a diet that included two spoonfuls of the dried grass daily.

Wartime Fort Is Now a Science Laboratory

BUILT by the Germans in the heart of Central Africa during the World War, a military fort is now used in the war waged by science against much smaller enemies than soldiers, namely, the dreaded tsetse flies, carriers of African sleeping sickness. Although the tsetse fly has been recognized for many years as a carrier of the disease, no way has been devised as yet to rid the continent of the deadly pest. In the remote outpost of science that was once a military garrison, medical experts are experimenting to discover an effective means of exterminating the fly that annually causes widespread sickness and takes a huge toll of human lives.



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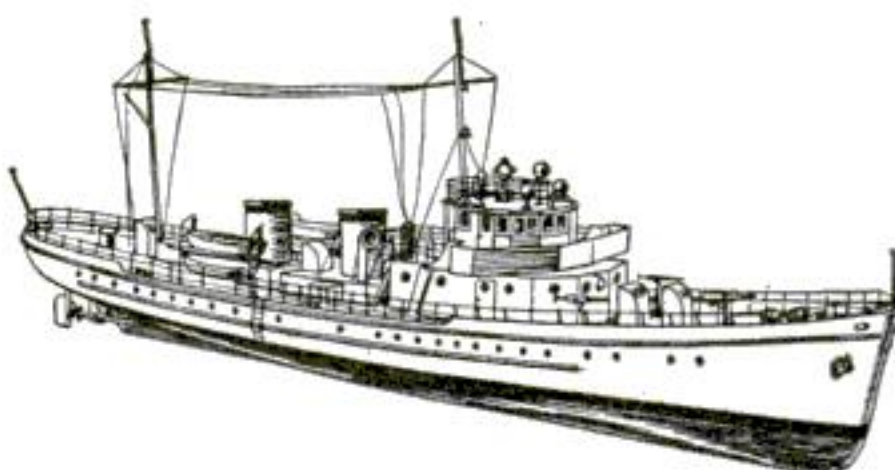
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(Continued on page 29)



Kit 5S—A Coast Guard patrol-boat model

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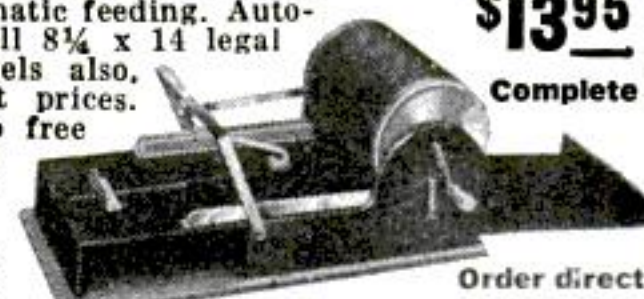
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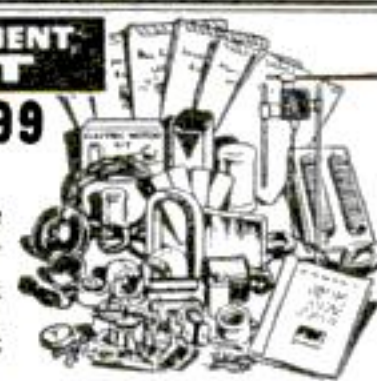
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Kits for Model Makers

(Continued from page 28)



Kit 1L—HO-gauge locomotive model

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R. U. S. cruiser <i>Tuscaloosa</i> , 11¾-in.	1.00
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Q. Privateer <i>Swallow</i> , 12½-in. hull, 20 in. over all.	4.95†
V. Clipper <i>Sovereign of the Seas</i> , 20½-in. hull, 26 in. over all.	4.95†
Y. Trading schooner, 17½-in. hull.	4.90†
2S. U. S. Navy destroyer <i>Preston</i> , 31½-in. hull.	5.95*
3S. <i>Constitution</i> ("Old Ironsides"), 21-in. hull, 31 in. over all.	6.50*
4S. Clipper ship <i>Great Republic</i> , 31½-in. hull, 42 in. over all.	8.40*
5S. Coast Guard patrol boat of new 165-ft. class, 20⅝-in. hull.	4.95*
6S. Brig <i>Malek Adhel</i> , ¼-in. scale, 20-in. hull, 33 in. over all, frame-and-plank construction.	9.75†
8S. Fishing Schooner <i>Bluenose</i> , 17½-in. hull, 22 in. over all.	4.95†
9S. Whaleboat, 14 in. long; partly shaped hull and raw materials for making all equipment.	2.75†
10S. Confederate raider <i>Alabama</i> ; steam sloop, bark rigged; 3/32-in. scale; 21½-in. hull, 28 in. over all.	8.20*

(Continued on page 30)



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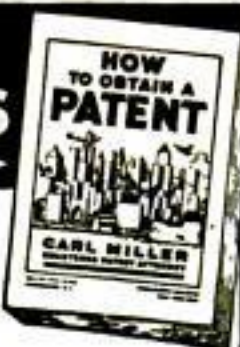
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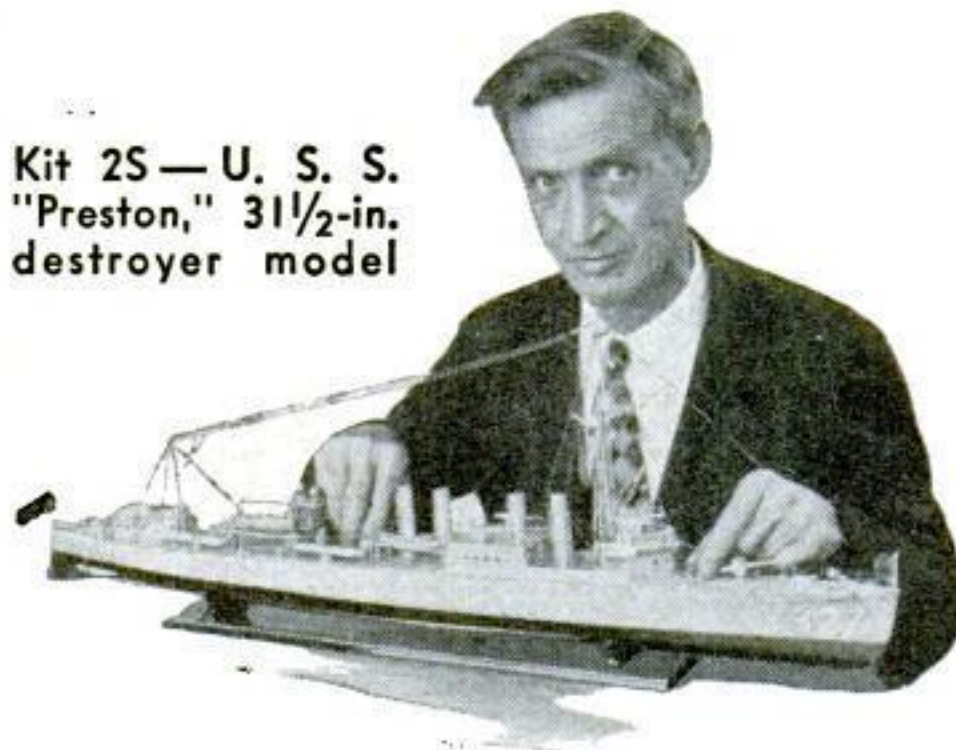
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Kits for Model Makers

(Continued from page 29)

Kit 2S — U. S. S.
"Preston," 31½-in.
destroyer model



MODEL RAILWAY KITS

- 1L. Model locomotive, Hudson
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(6-v.) and worm and gear..... 4.50
- 3L. Track kit. Contains running
rail, third rail, cardboard ties,
spikes, etc. for making 25 ft.
of HO track..... 4.00*
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except that kit contains third-
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dle, brush, and paint..... 1.50

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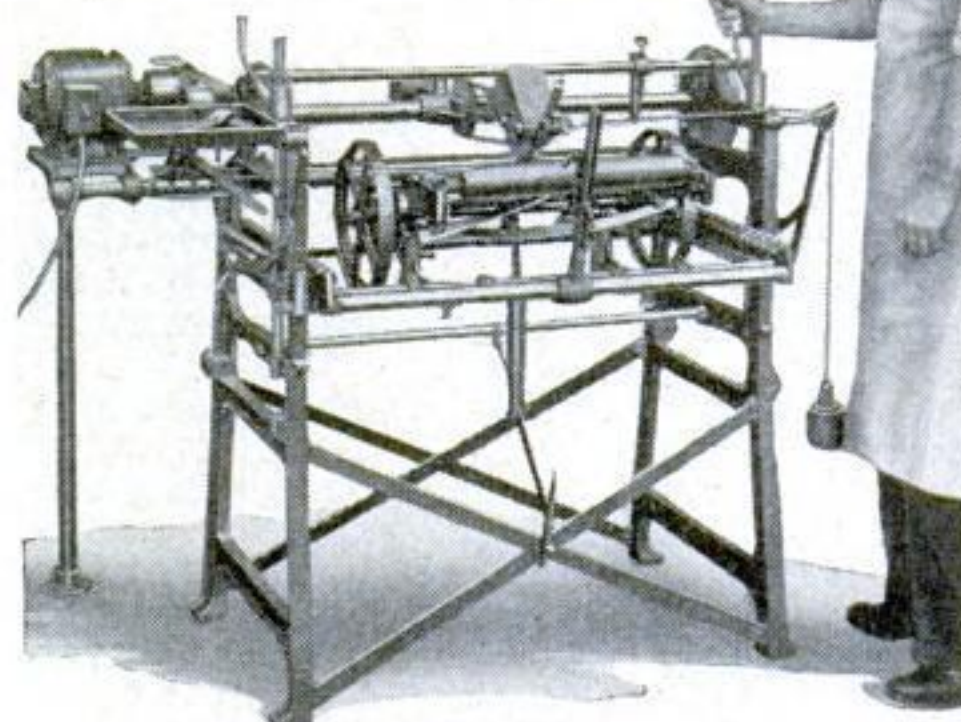
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Tree Leaves Regulate Their Temperatures

LEAVES of trees have their own air-conditioning systems, according to photographic studies made by Dr. W. E. Loomis and Dr. P. H. Carr, of Iowa State College. The scientists learned that leaves reflect most of the infra-red, heat-producing rays of sunlight, instead of absorbing them as heretofore believed. If the leaves absorbed the rays, they would literally be "cooked," it is claimed. The effect is to keep them cool, explaining why woodlands are cool in warm weather. In the case of evergreen trees, whose needles are their leaves, the needles change so that they can absorb the infra-red rays during cold weather, thus remaining warm enough to keep alive.

Tests Reveal Toads Have Homing Instinct

HOMING instincts as strong as those of pigeons that inexplicably return to their lofts when taken some distance away, are found to belong also to toads, experiments by Dr. Ray J. Nichols, of the University of Mississippi, have revealed. Dr. Nichols marked a number of toads in a certain area during several seasons, carrying them various distances away from the point of capture. Altogether, he captured, marked, and removed from their normal surroundings 141 toads, releasing them at distances up to a mile away. Sixty-three were subsequently recovered. Of that number, thirty had found their way back to home territory within periods of from two and a half hours to twenty-four days.

Nontamperable Fuses Reduce Fire Danger

NONTAMPERABLE electric fuses for household and other electric circuits are designed to make it impossible to replace burned-out fuses with copper-coins, pieces of low-resistance wire, and other articles whose use tends to defeat the fire-prevention purpose for which fuses are installed. Of plug-in type, the new fuses cannot be bridged internally, and plugs of different resistance ratings are not interchangeable. When a fuse blows out in a circuit thus equipped, it must be replaced with one exactly like it, doing away with dangerous makeshift repairs.

Novel Handkerchiefs Have Fourfold Use

HANDKERCHIEFS having each of their four quarters in a different color are the invention of James Price Weyman of San Antonio, Tex., to enable the wearer to choose a color to match his necktie, shirt, socks, or other apparel without the necessity of having a large supply of handkerchiefs of different colors. The novel handkerchiefs are cut to fit into the lapel pocket with less difficulty than the conventional kind.

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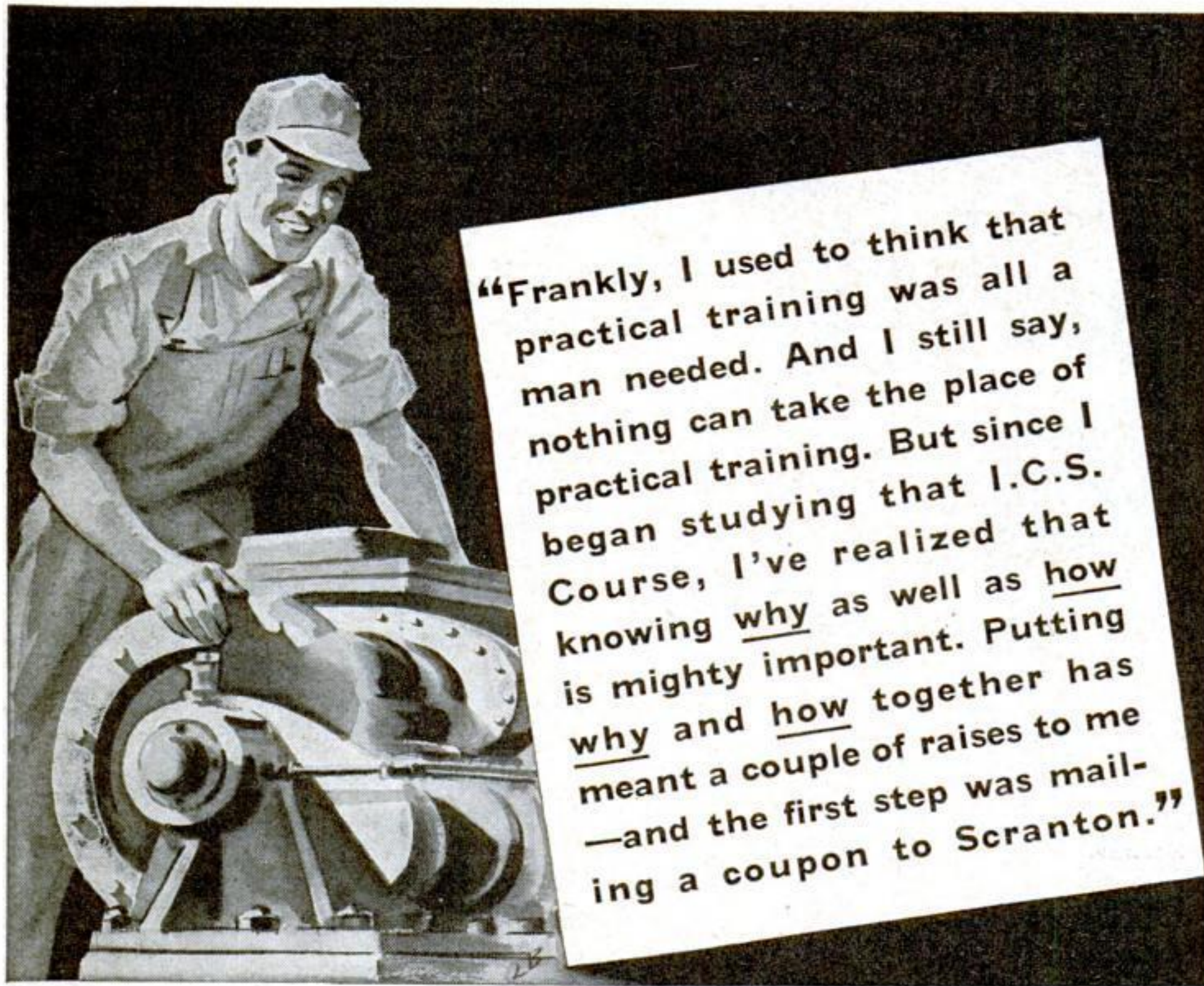
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Coil Spring Improves Micrometer Calipers

EQUIPPED with a tiny helical spring in place of the conventional ratchet, a new type of micrometer calipers devised by engineers of the Bell Telephone Laboratories, New York City, is said to be so designed that it can be used with a high degree of accuracy by the inexperienced as well as the experienced workman. Automatic control of the tension of the caliperlike jaws of the micrometer is the secret of the device. To simplify the operation and insure a more uniform pressure under all conditions, in the new micrometer the force is applied by a helical spring which needs only to be twisted through a fixed angle in order to apply the proper pressure. A knurled knob on the barrel is connected with the micrometer's movable spindle by means of the spring. When scribed lines on the knob match up with lines on the micrometer barrel, the proper tension is automatically applied, and recordings may be read from the markings.

Simple Chemical Spray Aids Mural Painters

EXTENDING the period of time during which artists may work in painting mural decorations, a new chemical mixture is sprayed on the surface of a wall every three hours to keep the pigments from drying out before the work is finished. For centuries, mural painters have sought a harmless solvent for the paint that would permit them to work longer than eighteen to twenty-three hours, the time it ordinarily takes paint to dry. Artists have been forced to rush each portion of a mural to completion within that time or leave the work unfinished because, once the paint has dried, a new application will not blend with it in the proper shades. The newly found treatment consists of spraying the surface with a mixture of butanol—butyl alcohol—and water mixed in equal portions. Miss Elizabeth Ely-de Vescovi Whitman, New York artist, and Gonzalez de la Vega, Mexican chemist, worked out the chemical formula for the process after many experiments with other mixtures.

Candy Box Has a Table of Contents

SELECTING candies from a candy box without the risk of getting one flavor when another is preferred, is made possible with an odd box devised by Gordon A. Petremont, of Boston, Mass. Appearing like a conventional candy box, the container has a color code printed on the cover by means of which each candy inside is distinguished by the color of its individual wrapper. Thus, a peppermint wrapped in green foil or paper, can be easily distinguished from a chocolate-covered marshmallow wrapped in a paper of another identifying color.

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Sound Movies Taken of Body's Interior

X-RAY moving pictures of the interior of the human body, accompanied by synchronized recordings of sounds produced by the organs or parts photographed, have been made possible through the efforts of Dr. Russell Reynolds, of London, England, and Dr. W. H. Stewart, of New York City. A third scientist, Dr. G. Schwarz, of Vienna, Austria, has added the technique of "fast-motion" photography to enable slow bodily processes to be speeded up in the film record for purposes of diagnosis and instruction.

Dr. Reynolds's contribution to the new process was a method of making X-ray movies of the human body without injury to the subject. Because ultraviolet rays damage body tissues that are exposed to them for considerable periods of time, it was necessary to find a way to make the required exposures as brief as possible. To accomplish this, X-ray tubes were constructed to withstand heavy charges, and high-voltage generators are employed to produce current considerably more powerful than that used in ordinary X-ray work. An ingenious synchronizing mechanism causes intermittent flashes from the tubes, keeping the X rays in radiation for only the tiny fraction of a second that the camera shutter is open.

In making the photographs, a motion-picture camera fitted with a special lens is trained on a fluorescent screen. As the X-ray images are cast on the screen by the flashes of the tubes, the camera records them on film. For making the sound recording, Dr. Stewart added a stethoscope of the kind commonly used by physicians in listening to sounds inside the body. This instrument was connected to sound-recording equipment, so that when the motion pictures are projected, the sounds are reproduced synchronously.

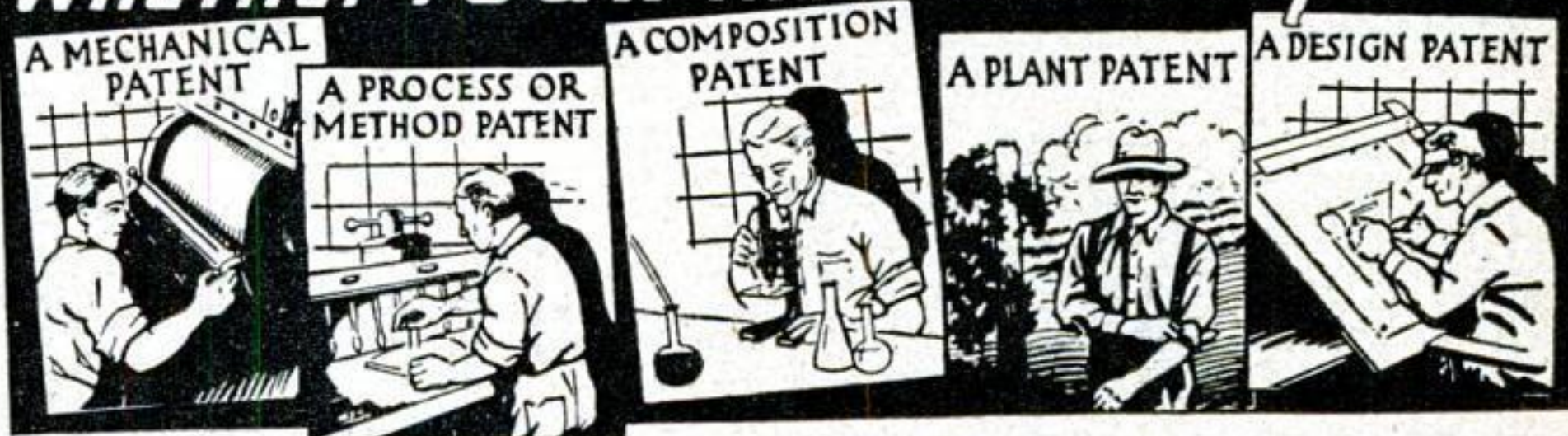
In addition to their value for diagnosis, the X-ray sound movies are expected to enable medical students to acquire in a very short period of time knowledge that otherwise would come to them only from months of study and internship.

Can Holds Whole Meal from Soup to Nuts

AN ENTIRE meal, consisting of soup, meat, vegetables, and possibly even a hot dessert, can be served on very short notice by heating of only one single can, according to claims made for a novel food container recently invented. Containing several compartments instead of the usual one, the can is packed with the various foods. When guests arrive unexpectedly, the housewife has only to take a canned meal from her storage shelves, heat the container in boiling water, and open it to serve the various dishes of a complete dinner.

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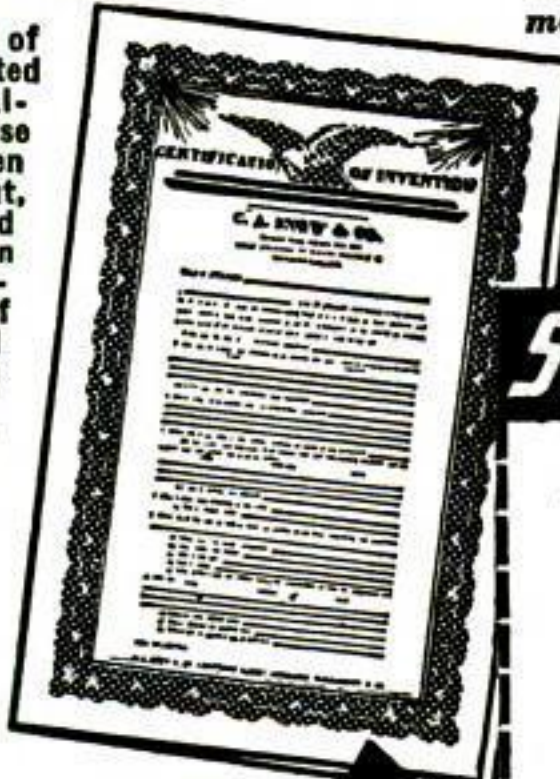
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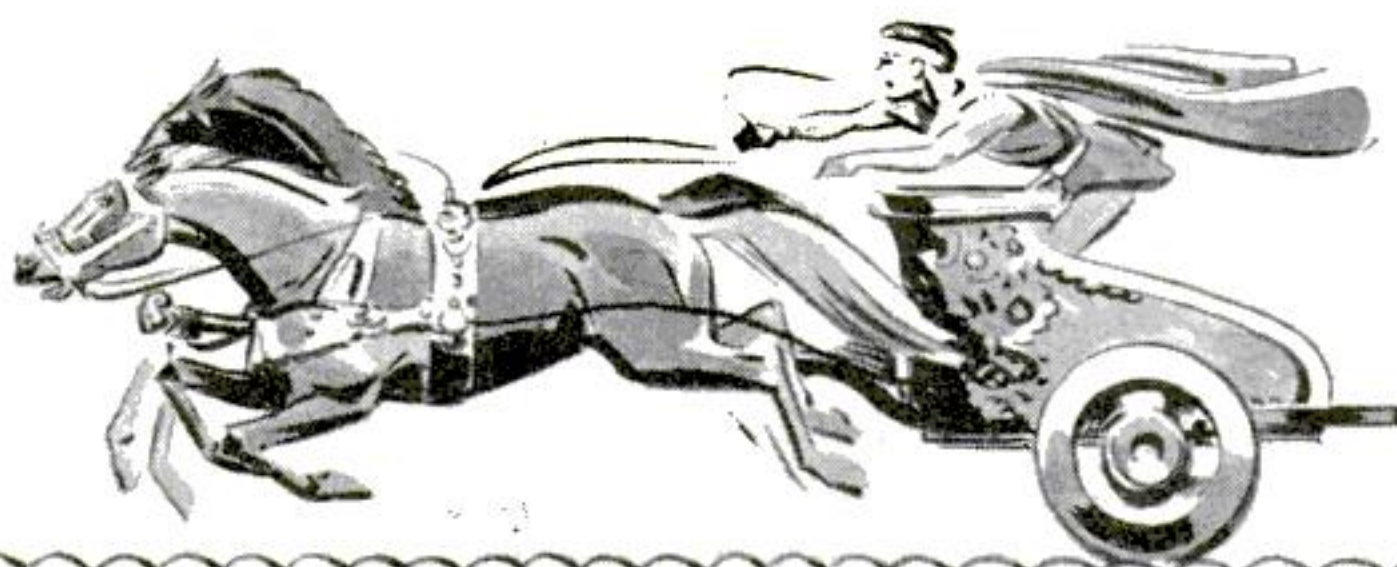
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City _____ State _____

KNEE-ACTION EASED THE RIDE 2000 YEARS AGO

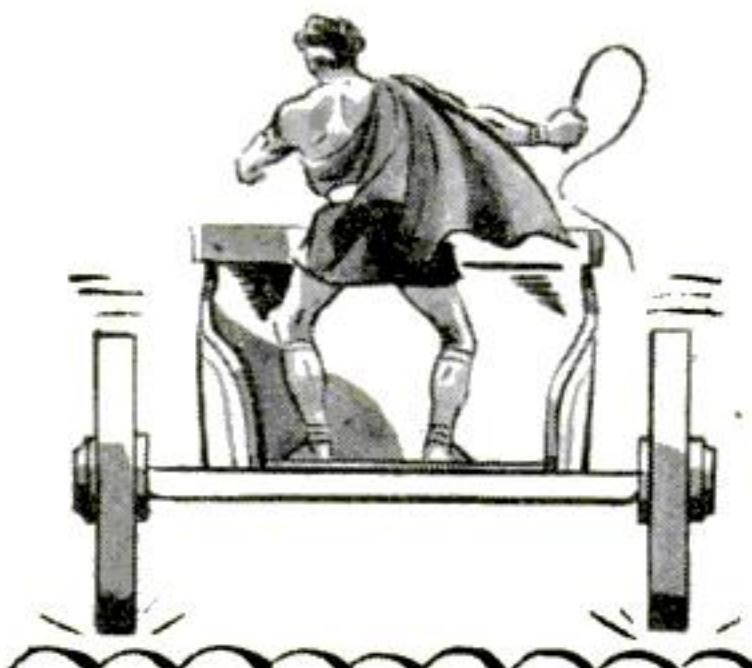
THE ANCIENT CHARIOT WAS A ROUGH-RIDING BUS, 100 PER CENT UNSPRUNG WEIGHT (IT HAD NO SPRINGS). BUT, THOUGH THE CHARIOT BOUNCED AND JOUNCED ALL OVER THE COBBLES, THE DRIVER DID NOT GET SHAKEN UP; HE ENJOYED A SMOOTH KNEE-ACTION RIDE.



Ben Hur Knew Knee-Action ... Here's How He Took the Bumps



CHARIOTEERS KEPT THEIR KNEES BENT, MUSCLES NOT TENSE BUT READY TO YIELD TO THE UPS AND DOWNS OF THE CHARIOT.

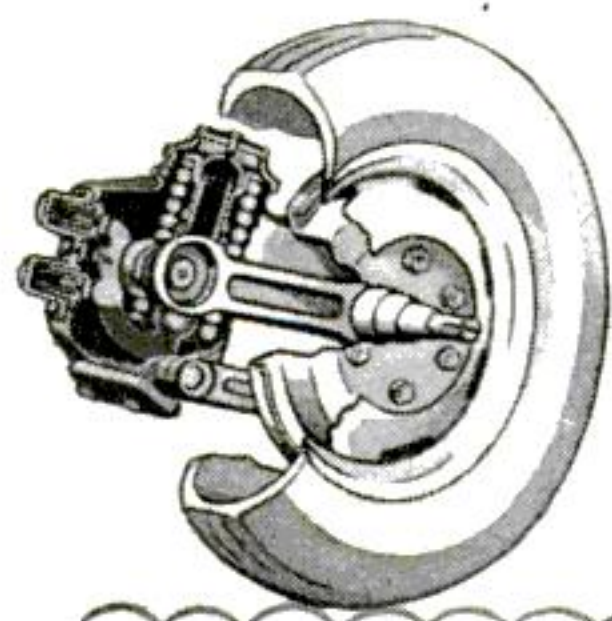


WHEN BOTH WHEELS BOUNCED, BOTH LEGS YIELDED, AND THE DRIVER'S KNEE-ACTION ABSORBED THE ROAD SHOCKS.

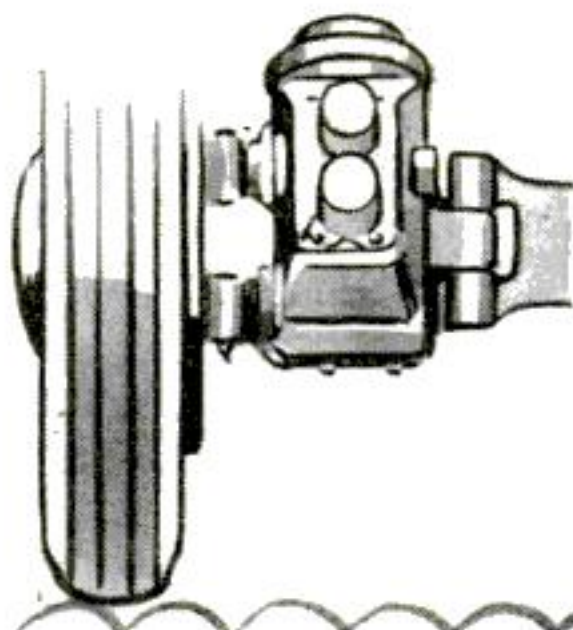


WHEN ONE WHEEL HIT A BUMP, TILTING THE CHARIOT, ONLY ONE KNEE YIELDED, AND THE DRIVER REMAINED UPRIGHT.

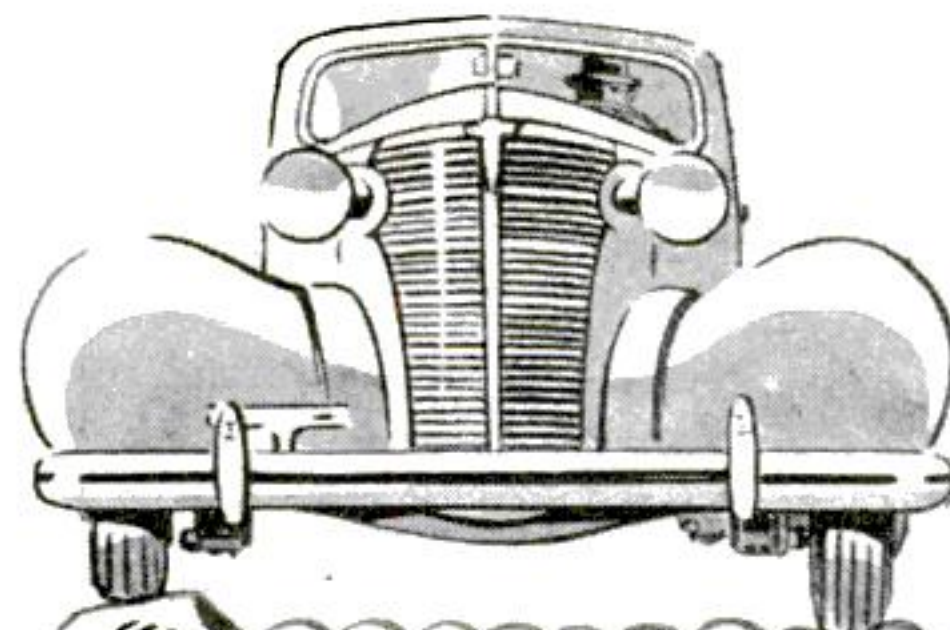
Here's How Knee-Action Smooths the Bumps in a Modern Car



HERE'S A SIMPLE DIAGRAM OF THE KNEE-ACTION UNIT OF A MODERN CAR-CHEVROLET. EACH FRONT WHEEL IS INDIVIDUALLY SUSPENDED.



FRONT VIEW OF A CHEVROLET KNEE-ACTION WHEEL. NOTE THAT THE KNEE-ACTION UNIT PIVOTS WITH THE WHEEL IN STEERING.



WHEN ONE WHEEL HITS A BUMP ITS KNEE-ACTION SPRING YIELDS. THE OTHER WHEEL IS NOT TILTED AND THE CAR NEITHER TILTS NOR PITCHES.

Before Knee-Action was introduced, front wheels of motor cars were mounted on a solid front axle. When either front wheel rose over a bump, it tilted the axle and the opposite wheel, causing difficulties with spring suspension and steering. Knee-Action lets each wheel act independently. Chevrolet's exclusive type of Knee-

Action not only gives the best ride known to motoring, but makes possible true shockproof steering, since no part of the steering linkage moves up and down with the front wheels. If you have never experienced the pleasure of driving a Knee-Action Chevrolet, try the new 1938 Master DeLuxe model and see what a difference it makes.

CHEVROLET MOTOR DIVISION, General Motors Sales Corporation, DETROIT, MICHIGAN

You'll be **AHEAD** with a
CHEVROLET

POPULAR SCIENCE

Monthly

RAYMOND J. BROWN, *Editor*

• BUILDING A WORLD'S FAIR

By EDWIN TEALE

FIFTY MILLION visitors—a number equal to nearly half the population of the United States—are expected to journey next year to the New York World's Fair. With lights and flame, motion and sound, this \$175,000,000 show will dramatize the progress and the promise of science. It will reveal the World of Tomorrow as it is foreseen today.

At this writing, the exposition site is a vast beehive of activity. The pounding of carpenters' hammers, the crash of pile drivers, the roar of dump trucks, the machine-gun rat-a-tat of riveters fills the air. Buildings seem to rise overnight. A thousand and one projects are being carried out at the same

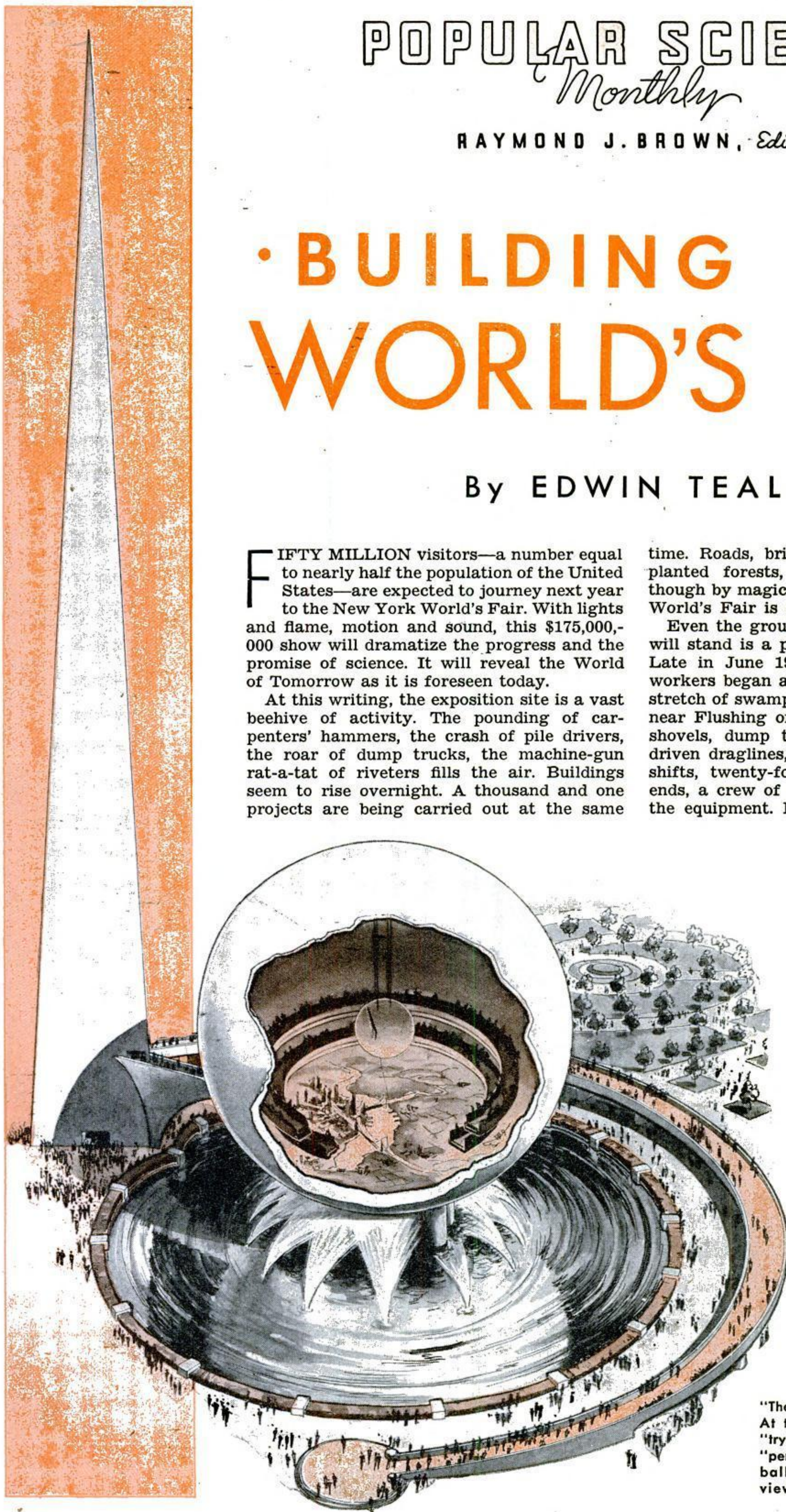
time. Roads, bridges, artificial lakes, transplanted forests, synthetic soils appear as though by magic. The whole story of the 1939 World's Fair is a story of science in action.

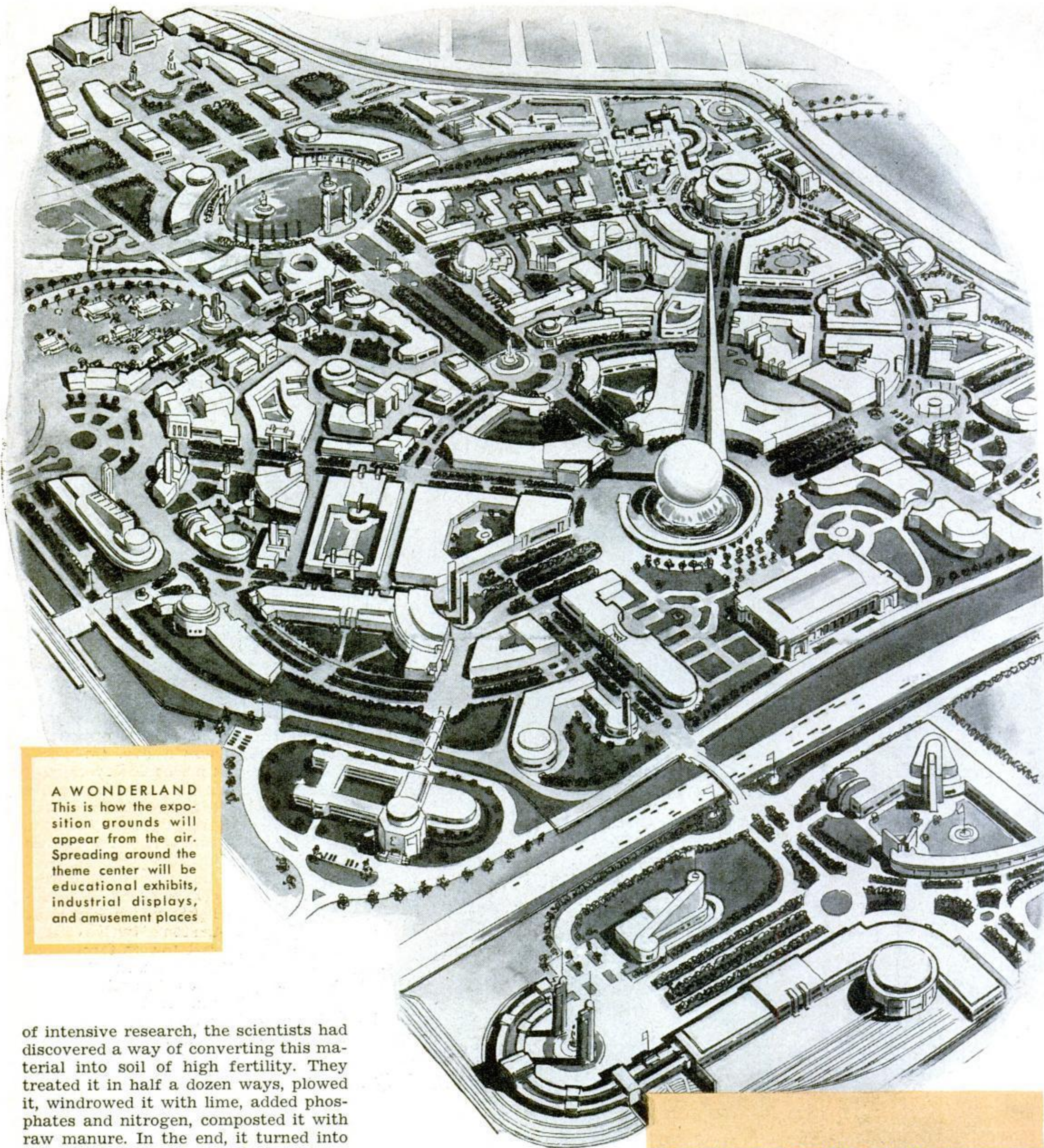
Even the ground upon which the buildings will stand is a product of scientific advance. Late in June 1936, a mechanized army of workers began a 190-day siege of the dreary stretch of swampland, formerly an ash dump, near Flushing on Long Island. Using power shovels, dump trucks, bulldozers, and gas-driven draglines, 500 picked men worked, in shifts, twenty-four hours a day. On weekends, a crew of crack mechanics overhauled the equipment. During the operations, more

than 1,000,000 gallons of gasoline exploded in the cylinders of the engines and \$80,000 worth of electric current was consumed by the floodlights which blazed at the top of twelve eighty-foot towers throughout the night. In all, nearly 7,000,000 cubic yards of material were moved before the job was completed.

Then followed an exhibition of chemical wizardry. Instead of stripping hundreds of acres to obtain the fertile topsoil needed for grass and trees, scientists created it chemically from the salty, acid, fibrous root soil of the swamp, of which approximately 800,000 cubic yards had been set aside for the purpose. Through two years

"Theme center" of the fair. At the left is the 700-foot "trylon," and beside it the "perisphere," a huge hollow ball in which visitors will view a city of the future





A WONDERLAND

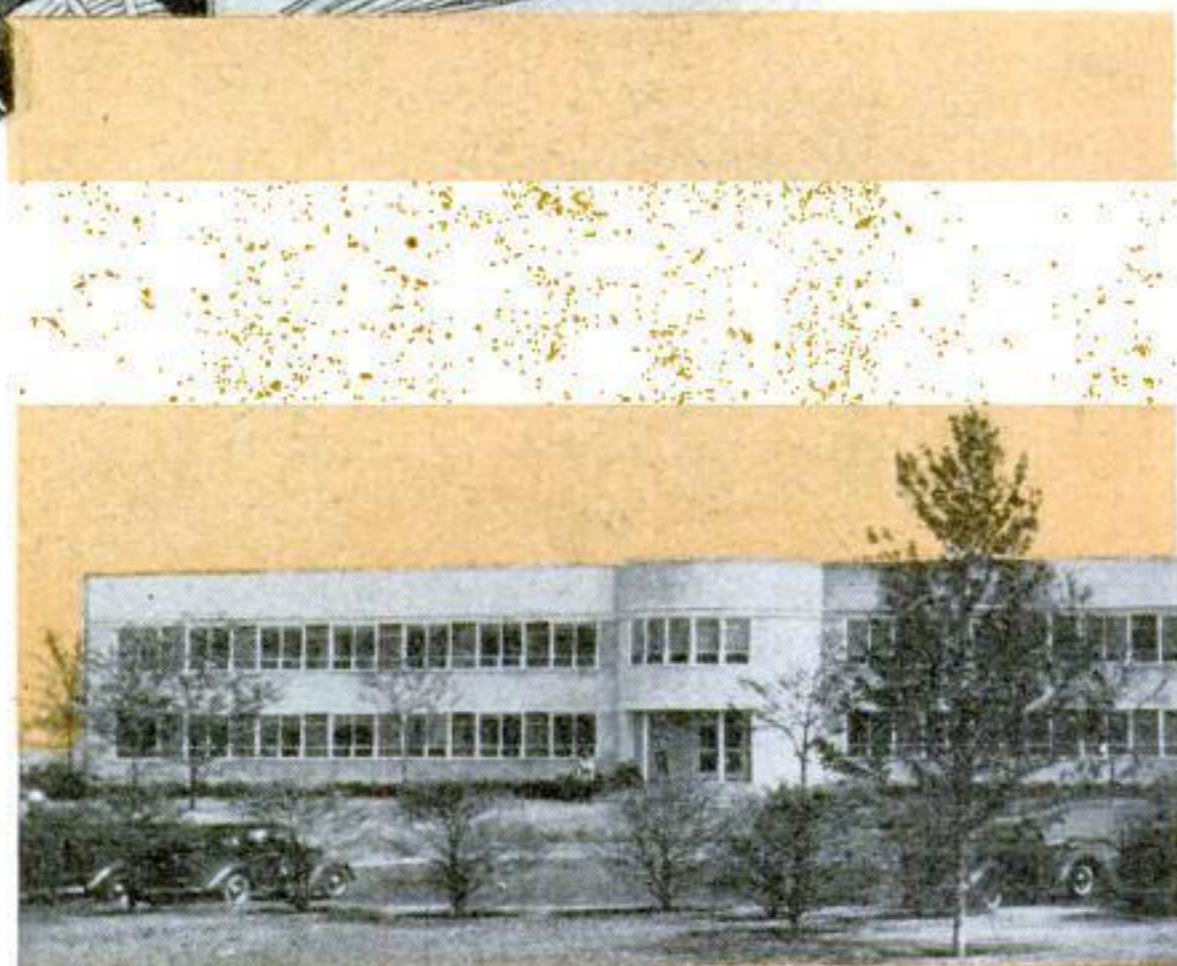
This is how the exposition grounds will appear from the air. Spreading around the theme center will be educational exhibits, industrial displays, and amusement places

of intensive research, the scientists had discovered a way of converting this material into soil of high fertility. They treated it in half a dozen ways, plowed it, windrowed it with lime, added phosphates and nitrogen, composted it with raw manure. In the end, it turned into the material desired. By this feat alone, science saved the fair half a million dollars.

For the landscaping of the fair grounds, a forest of trees began moving toward the site. Experts, equipped with large books giving the sizes, shapes, and kinds of trees required, had been scouring the country for hundreds of miles around. They had catalogued upward of 10,000 available trees. In the largest mass movement of the kind on record, railroad flat cars and motor trucks began rolling toward New York bearing a wide variety of full-grown trees, some weighing as much as twenty-five tons and having a height of more than fifty feet. Following one-way streets and guided by

police cars, most of the trucks passed through New York City in the early hours of the morning, reaching their destination before daylight. Here, huge machines lifted the trees into place while Diesel-driven bulldozers shoved the dirt around the roots and ran back and forth to tamp it down.

This migration of 10,000 trees, dramatic as it is, forms but a small part of the vast activity necessary in the preparation of the fair site. On the list of jobs to be done were the



Already built, the administration building of the

construction of seventeen miles of roads, fifteen miles of gas mains, ten bridges, and two artificial lakes. A tidal dam and a \$700,000 marine basin on Flushing Bay, which will permit motor boats and excursion vessels to dock at the grounds, are well on their way to completion.

At the same time, the first of the buildings which will form the rainbow-hued Arabian Nights assemblage of the fair, were going up. To be sure that the best obtainable materials were used, the exposition scientists built a curious field laboratory unlike any other in existence. Supported on immense jacks, the structure could be warped and twisted at the will of the engineers. Under actual outdoor conditions, they were able to subject materials, ranging from stucco to steel beams, to a wide variety of tests.

Most spectacular of the structures being made from the selected materials are the "trylon" and "perisphere," which will form the "theme center" of the fair. The first is a slender obelisk rising 700 feet into the air; the second is a pure-white ball 200 feet in diameter. They can be seen for miles around and will provide a landmark for visitors arriving by air, water, and land.

To form the foundation for the 8,000,000-pound trylon, eleven miles of wood piling, a whole inverted forest of ninety-five-foot fir trunks, were driven into the ground. The designs for the trylon and perisphere were selected from more than 1,000 sketches submitted. The cost of construction will be \$1,200,000.

Within the hollow globe of the 5,700,000-pound perisphere, "magic carpets" will carry visitors in a circle above an immense model representation of a city and countryside of the future. Two 100-ton platforms, shaped like gigantic metal washers, will form the "carpets" on which spectators will ride. Special lighting will make the supporting pillars invisible while the platforms revolve at a steady pace of thirty feet a minute. Visitors will have the sensation of riding silently through space above a wide-spread countryside.

Outside the perisphere, water, spraying from a series of fountains, will hide the

eight columns which provide support. The great ball, nearly a block in diameter, will appear to be floating in space. At night, colored lights and moving patterns will be projected on the outside of the sphere, producing the illusion that it is revolving.

To carry spectators to the entrance of the perisphere, five stories above the ground, the longest moving stairway ever built in this country will be provided. A steady stream of 16,000 persons an hour will be able to ride up the incline. After the trip through the perisphere is over, visitors will descend to the ground by means of a circular ramp. During this descent, they will have an opportunity to view the whole colorful panorama of the fair spread out below them. A sweep of the grounds will carry the eye through all the colors of the spectrum, succeeding one another in their proper order, from red to violet.

Spreading away from the theme center of the fair will be a seemingly endless succession of exhibits. Among the most spectacular will be the gas-industries display with its tall central plume of fire and its quartet of ninety-foot pylons, each with writhing snakes of colored flame running up the sides. In order to obtain the desired colors, experimenters worked for months adding chemicals to gas in laboratory tests. As a result, they have half a dozen brilliant hues at their disposal. At present, attempts are being made to mix fire and water, combining fountain sprays and colored flame. During the exposition, men operating batteries of valves within the "Court of Flame" exhibit will control and blend the varicolored plumes of fire.

The consumption of gas by all the exhibits of the fair, during the six-months' run of the exposition, is expected to reach a total of nearly half a billion cubic feet. The fifteen miles of mains, which form an underground network at the site, have sufficient capacity to meet the needs of a large city.

The biggest single display at the fair will be the sixteen-acre, \$1,500,000 show presented by *(Continued on page 120)*



SPECTACULAR COURT OF FLAME

One of the most striking exhibits will be that of the gas industries, seen in the drawing above. Around a tall plume of colored flame will stand four massive towers, each wreathed in fire



fair is an example of the modern design and scientific construction being used. It is air-conditioned throughout



Science Sets New Sports Records

Ralph Flanagan, a twenty-year-old swimmer who rose to the front rank with a new stroke

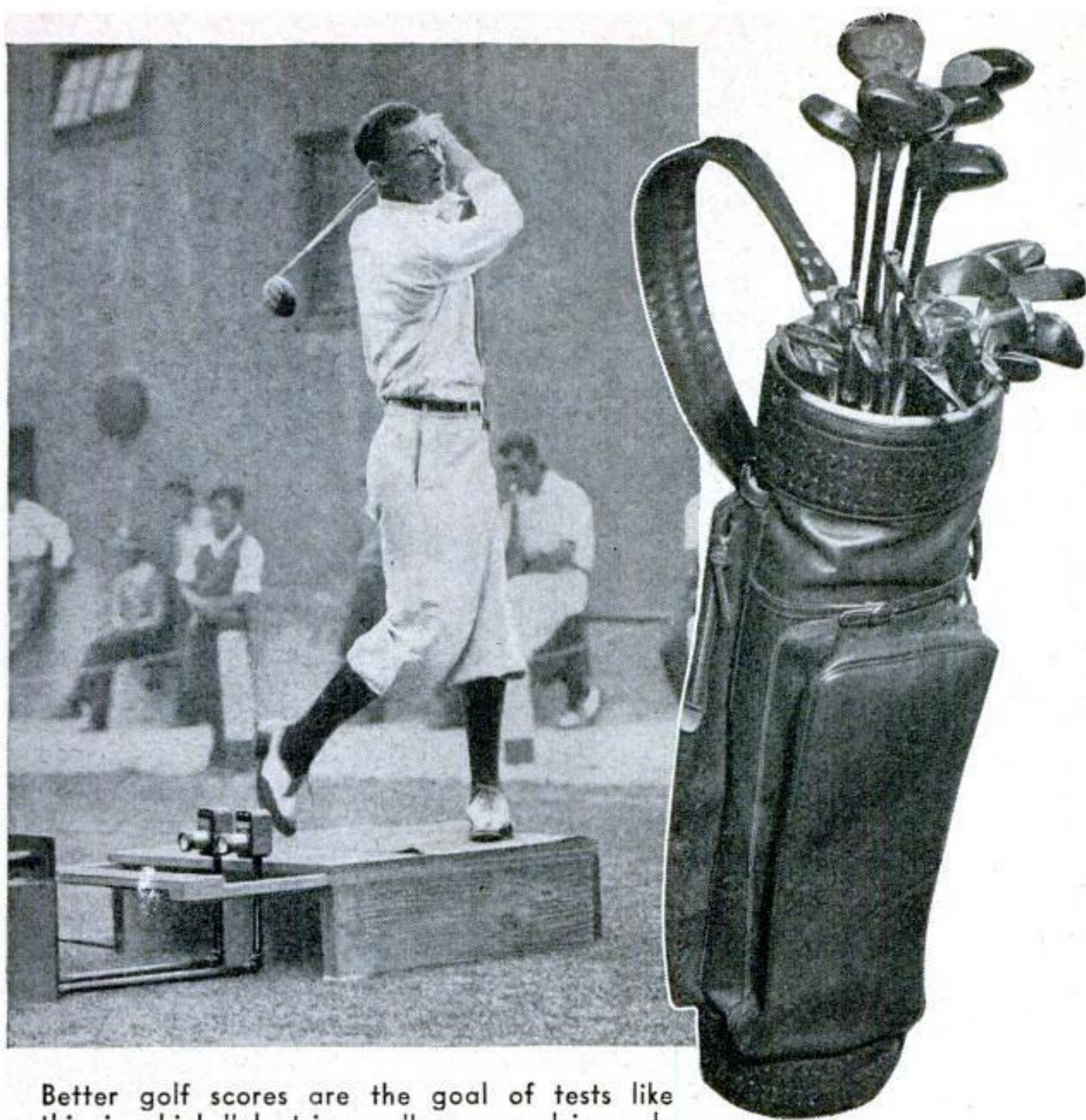
JOHN E. LODGE Tells How Technical Research Teaches Athletes To Surpass the Feats of Performers of the Past

TIME-HONORED records went by the board last year in an unprecedented assault upon world marks by American and foreign athletes. They ran and swam faster, leaped and vaulted higher, in 1937 than any man had ever done before. Dazzling performances by stars of the pool and the cinder track proved that if there is a limit to a human being's physical powers, it has yet to be found.

Since Olympic Games records began to be kept in 776 B. C., there has been no fundamental change in the human machine. Athletes today compete in similar events, with the same physical equipment, and under substantially the same rules as they did in ancient Greece amid the temples of Olympia. Yet accurate modern timing has shown that athletic performances are steadily becoming better with the passing years. Not



Skiing, now one of the most popular winter sports, may be completely changed by new scientific studies. Experts say that many of the turns beloved by veteran skiers are worthless



Better golf scores are the goal of tests like this, in which "electric eyes" were used in working out new designs to make clubs more efficient

a single one of the present track and field records for men in the Olympic Games, for example, dates farther back than 1932. How is it possible for modern stars to have outstripped their competitors so completely?

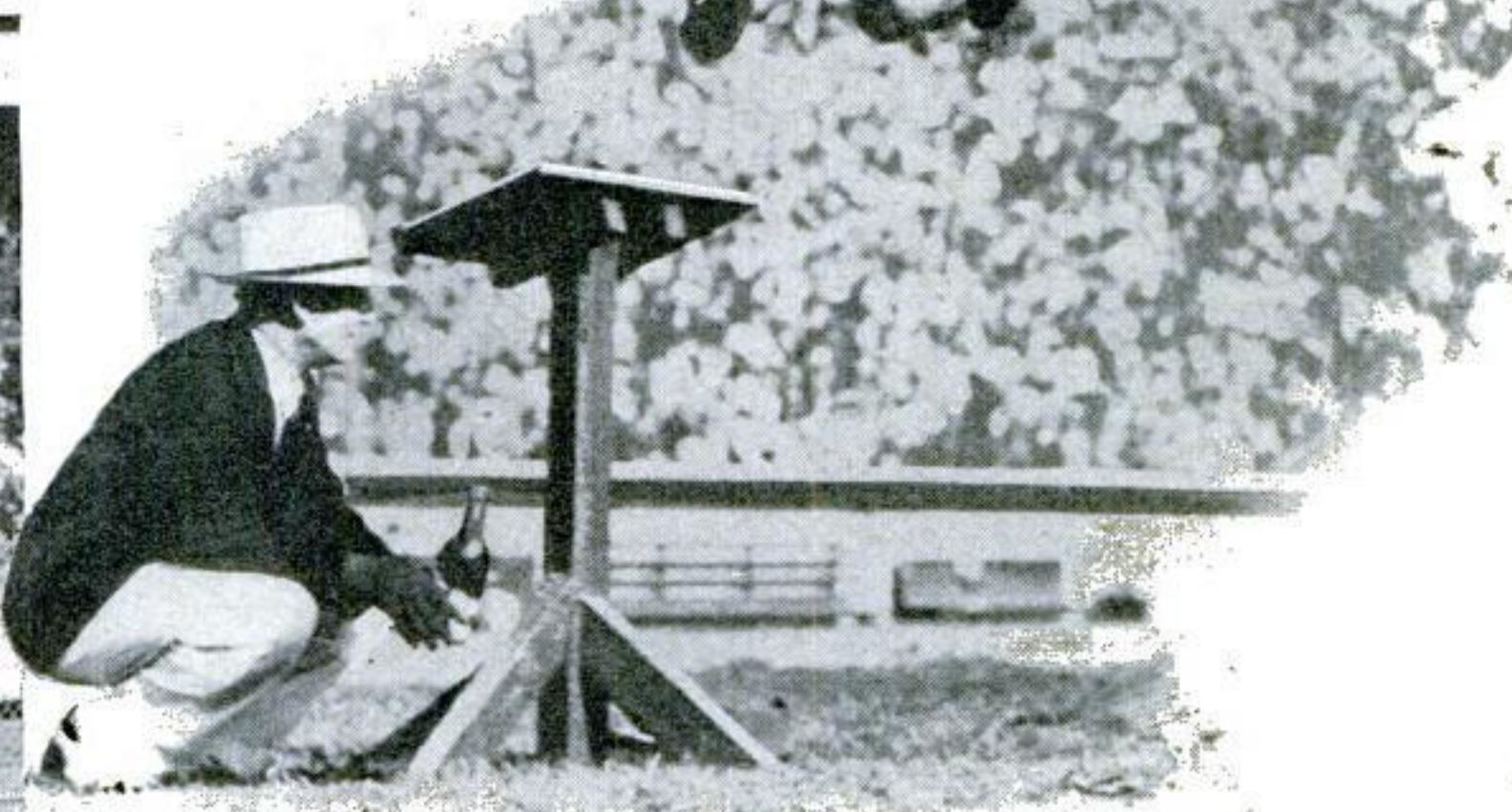
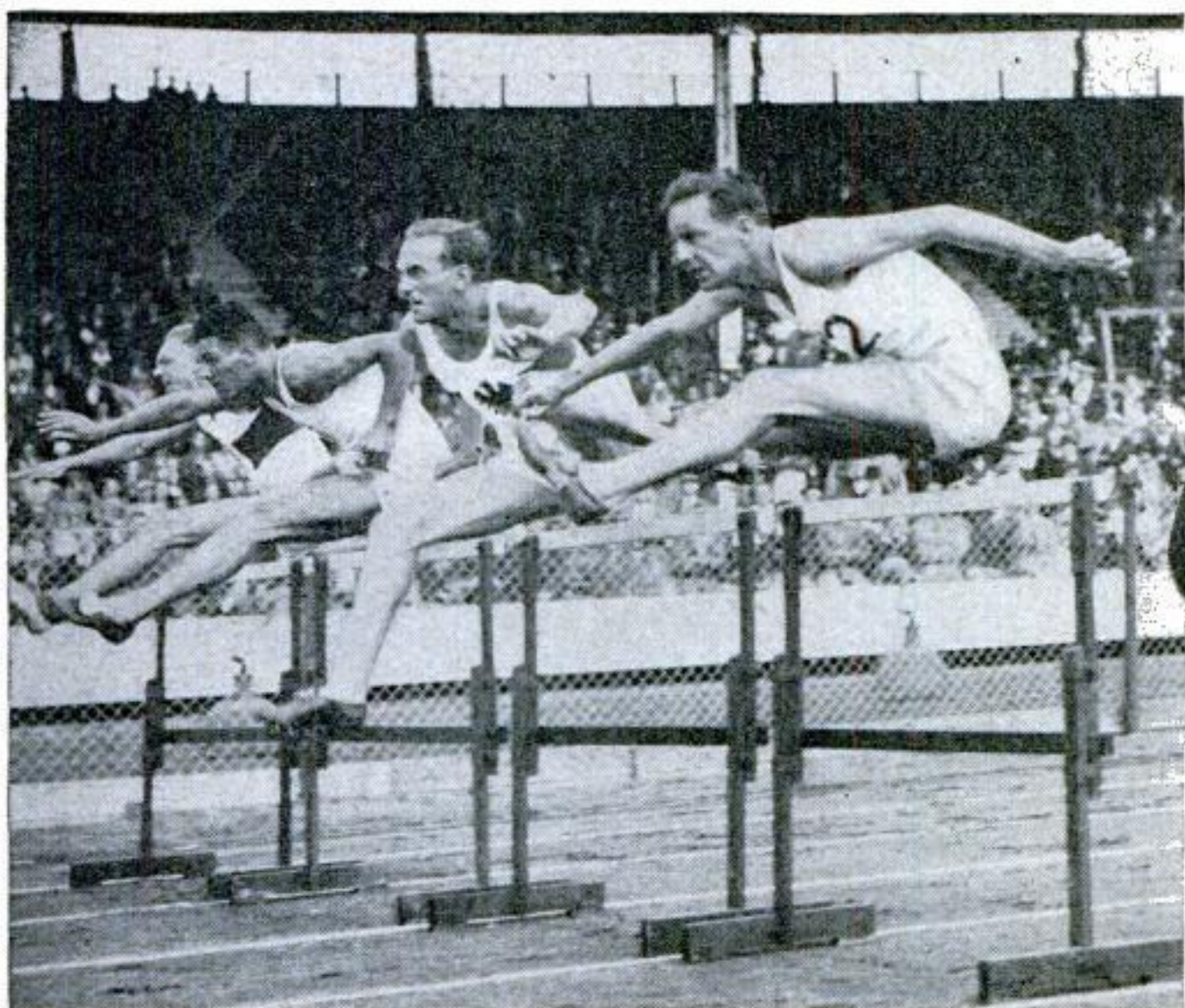
The answer is that science, having presented us with airplanes, racing cars, and streamline trains to conquer space and time, has also turned to improving man's feats under his own power. Motion studies with high-speed cameras, and ingenious applications of scientific laws, are teaching athletes how to obtain the utmost efficiency from their own muscles. Falling records tell the result.

Imagine being able to jump over the head of the tallest man you meet on the street, without even knocking off his hat. Then you can appreciate the amazing high jump of six feet and ten inches performed last August by Melvin Walker of Ohio State University.

When M. F. Sweeny of the New York Athletic Club cleared the bar at the world-record height of six feet, five and five eighths inches, away back in 1895, that was considered just about the limit of human power in high jumping. It was, by the methods known then. Events since that time have proved conclusively that no one knows "instinctively" how to jump as high as he can. It is a problem to be solved by the science of ballistics, for a human projectile follows the same natural laws as a shell fired from a gun or an airplane shot from a catapult. Thus the march toward modern records really began in 1912 when George Horine introduced into high-jumping the "western roll"—a mathematically designed leap *(Continued on page 118)*



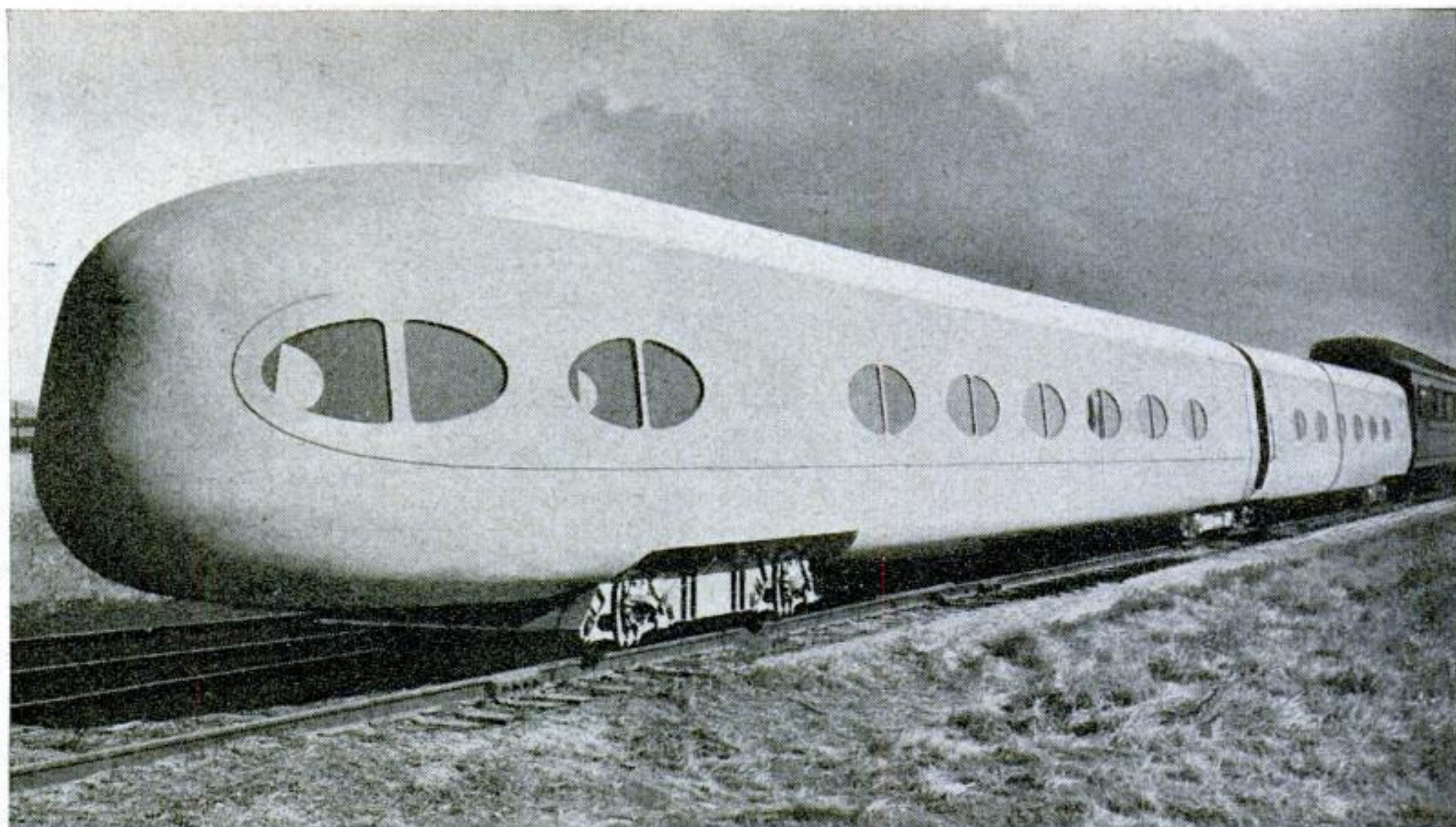
Earle Meadows, Olympic pole-vault champion, clearing the bar at fourteen feet and eleven inches. Not so long ago, thirteen feet was believed to be the very limit for this event



Jesse Owens, phenomenal Negro athlete, demonstrating the form that enabled him to break the world's record for the broad jump. Left, runners taking the high hurdles with new speed technique

Streamline Cars Bank on Turns

SWUNG from special hammock-like supports, streamline railroad coaches of radical design were given their first test run recently on a branch line near Inglewood, Calif. The two articulated coaches are supported by three wheel trucks so as to form one unit. Weighing more than 20,000 pounds less than those in general use today, the new cars have an extremely low center of gravity which, with their novel wheel mounting, allows them to bank on turns much as an airplane does. Although the cars appear smaller than those on other streamline trains, they have eight feet of headroom inside from the floor to the curved ceiling.



Special wheel suspension and low center of gravity give these streamline coaches high speed



Tropical Desert Plant Heals Radium Burns

BURNS caused by radium and by X rays are being successfully treated with aloe vera, a tropical desert plant shown in the photograph reproduced above. The thick fleshy leaf of the plant contains a gelatinous inner surface which is applied to the burned portion of the skin. Requests for the plant have been made at botanical gardens in various cities for use in treatment.

Alarm Clock Tells Date

CLOCK, calendar, and alarm are combined in one timepiece just placed on the market. Controls for setting the alarm and the rotary-type clock and calendar dials are housed inside the dome top of the instrument, which is seen in the photograph at the right.



Engineer examining one of the boilers that generate steam from refuse at the new disposal plant

At the right, a traveling crane is dumping a load of garbage into the mouth of the mammoth furnace

Novel Traveling Bag Is Collapsible

A HANDY item for travelers is a new collapsible bag that folds up to the size of a brief case when not in use. Fitted with a slide fastener that runs the full length of the bag, the outfit is made of tan duck stoutly bound with cowhide. Taken along on a trip, it provides extra carrying space. The bag is available in three different sizes.

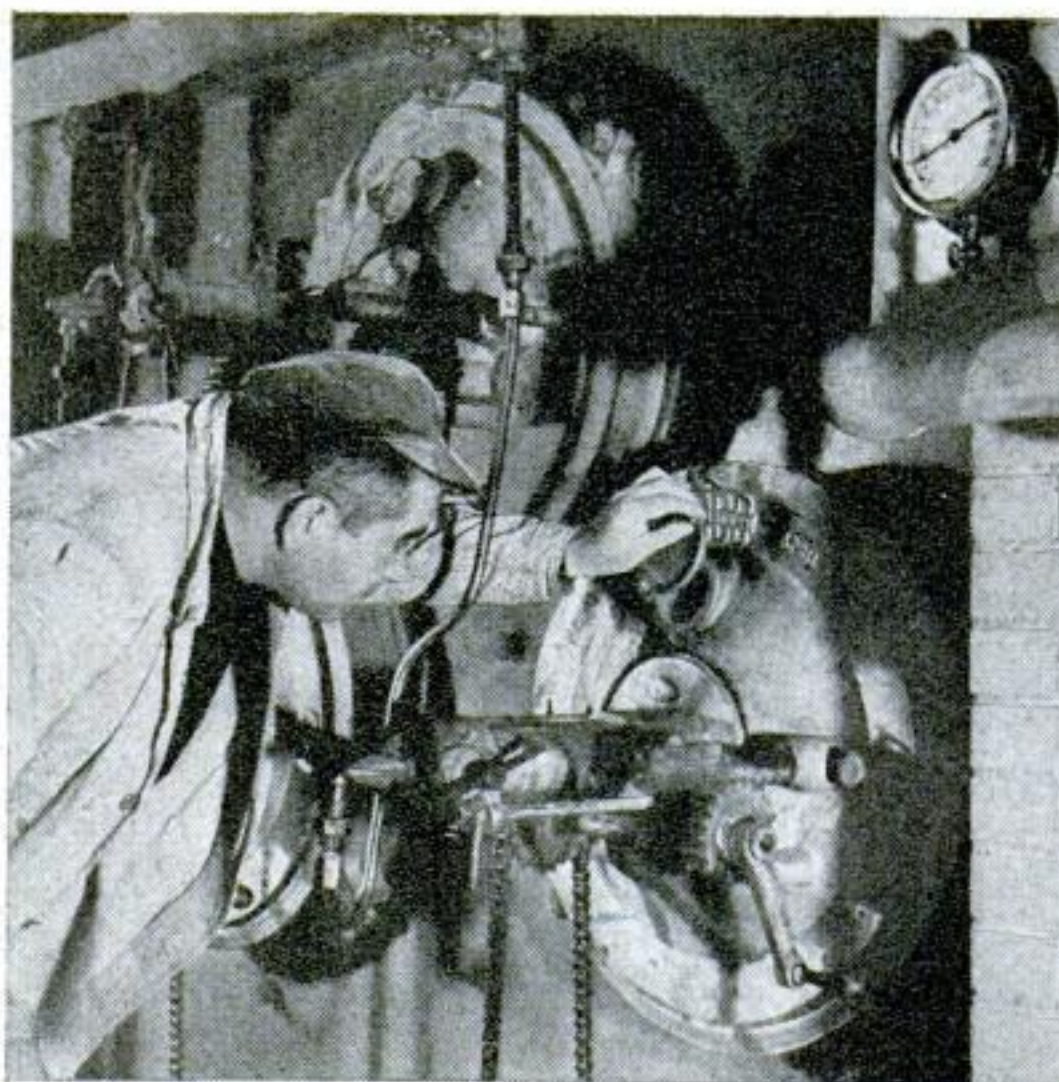
Collapsible traveling bag folded for storage and, at right, opened for use



Incinerator Turns Garbage into Electricity

GARBAGE and refuse are converted into electricity in the largest incinerator in the world, now in service in New York City. After garbage trucks have piled up the refuse, giant metal jaws

grab huge loads of the material, run along overhead tracks, and dump it into a concrete trough at the mouth of the incinerator. A trapdoor is then opened to let the material fall down into the incinerator furnace. The burning refuse produces heat to create steam, which in turn drives a set of turbines for the generation of electric power. Before the completion of the incinerator power plant, garbage collected in New York City was piled into scows and towed out by tugs to be dumped into the Atlantic Ocean.

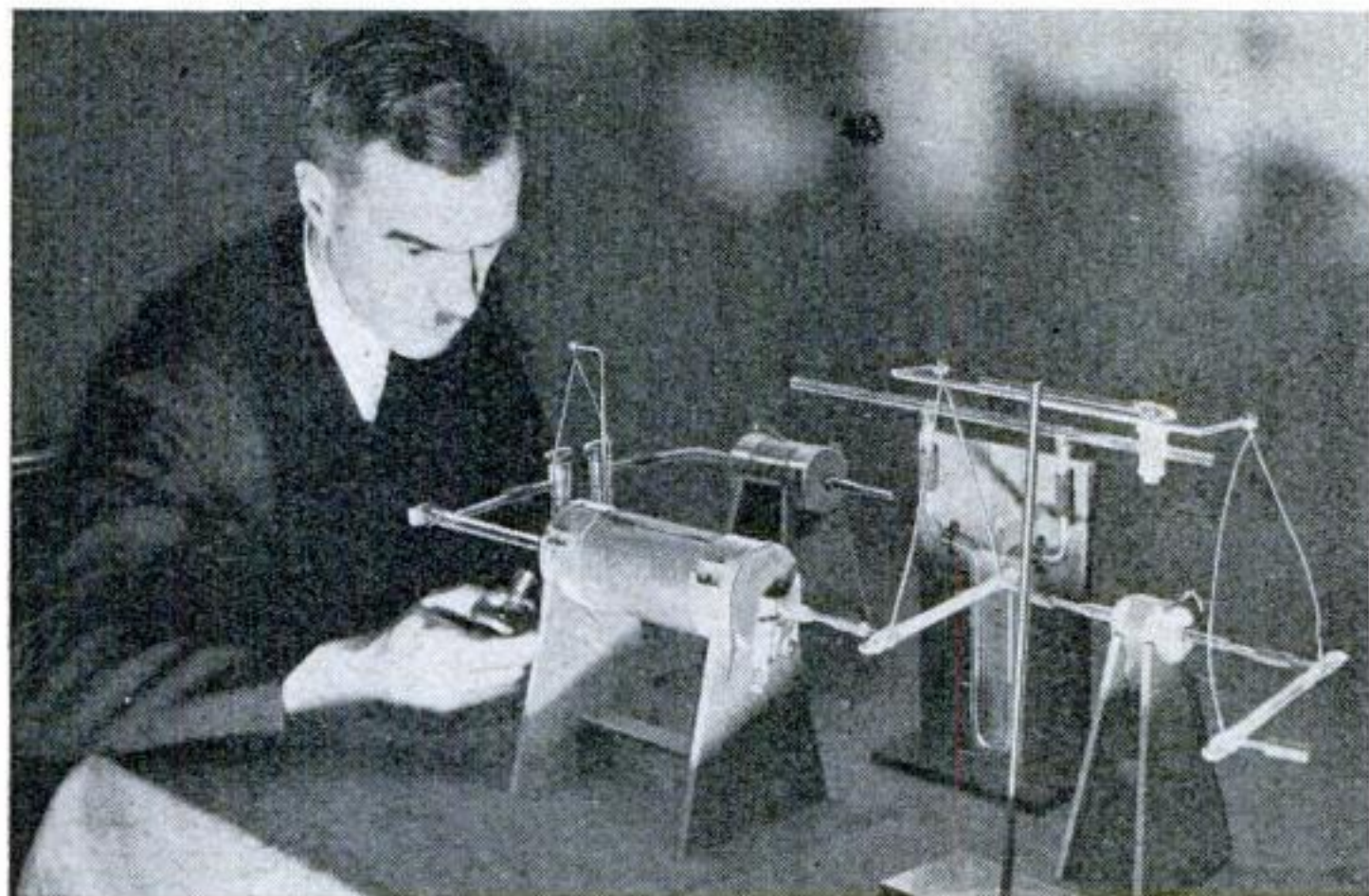


Airport Antenna Reduces Static

FOLLOWING months of laboratory tests, air-line engineers recently announced the development of an anti-static loop antenna for use by ground radio stations. Resembling a large hoop, the new device is five and a half feet in diameter. The loop casing is made of aluminum, while the antenna itself consists of a single strand of copper wire supported within the loop by a series of porcelain beads. The loop antenna is set up outdoors.

Machine Analyzes Molecules

DUBBED a "molecular architect," Dr. Alsop H. Corwin, of Johns Hopkins University, Baltimore, Md., is shown in the photograph below examining an ingenious "microcombustion" apparatus which he has just completed. With the instrument, it is said to be possible to analyze the structure of a molecule, determining just how many atoms it would take to construct one of a given size.



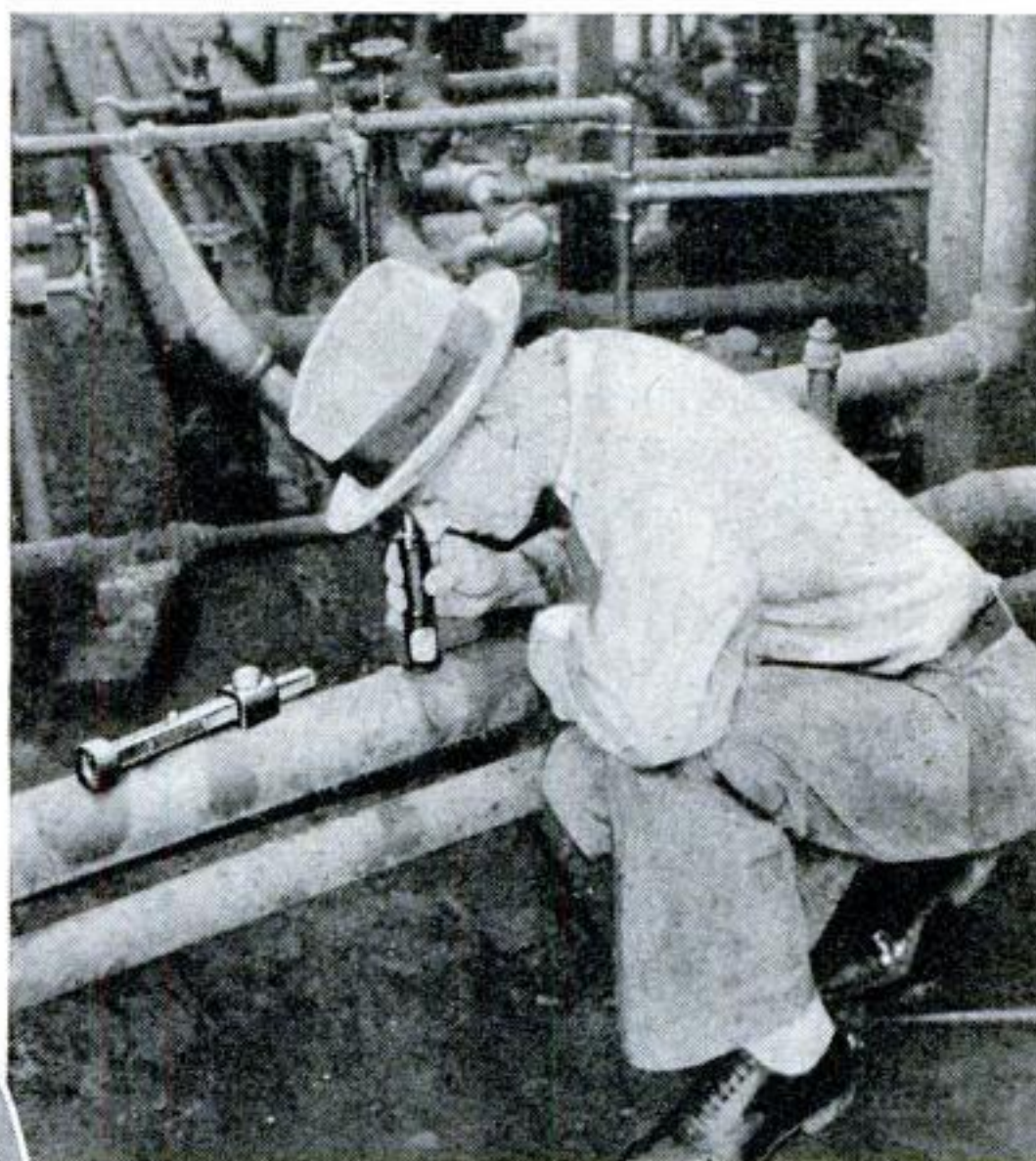
Dr. Alsop H. Corwin operating his ingenious atom-counting machine



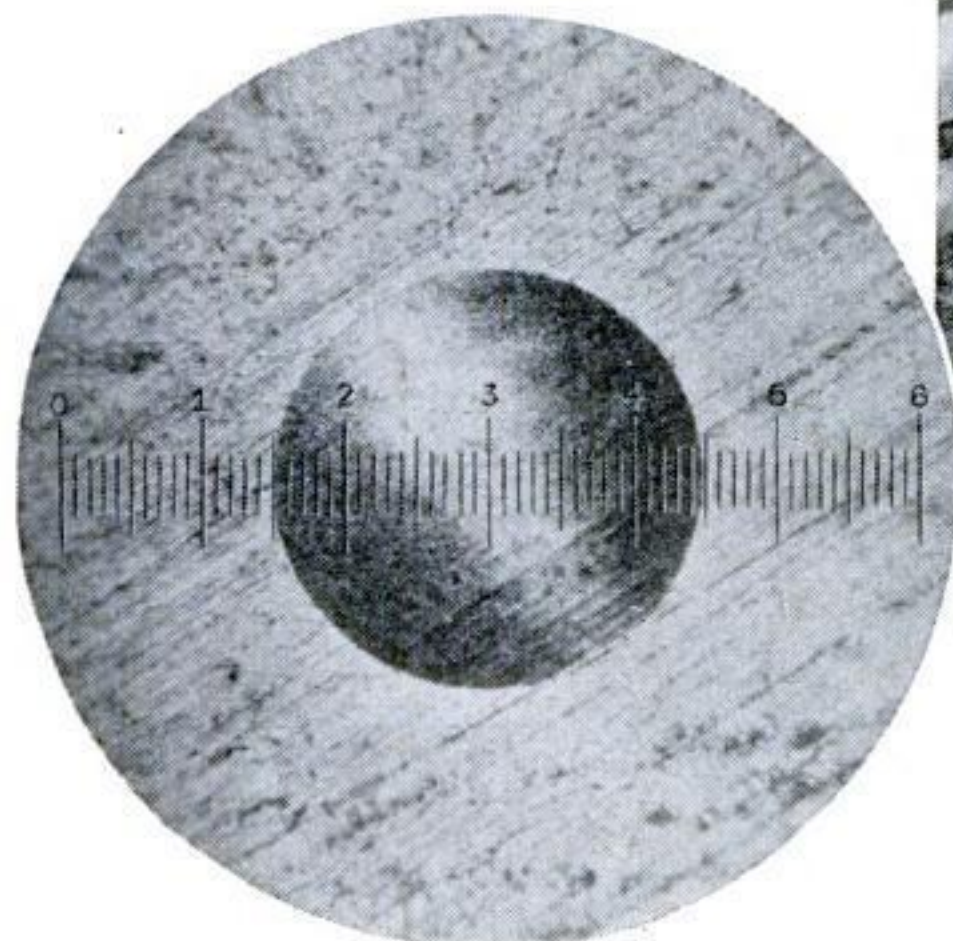
Resembling a giant hoop, this loop antenna for airports cuts static

Portable Outfit Tests Hardness of Metals

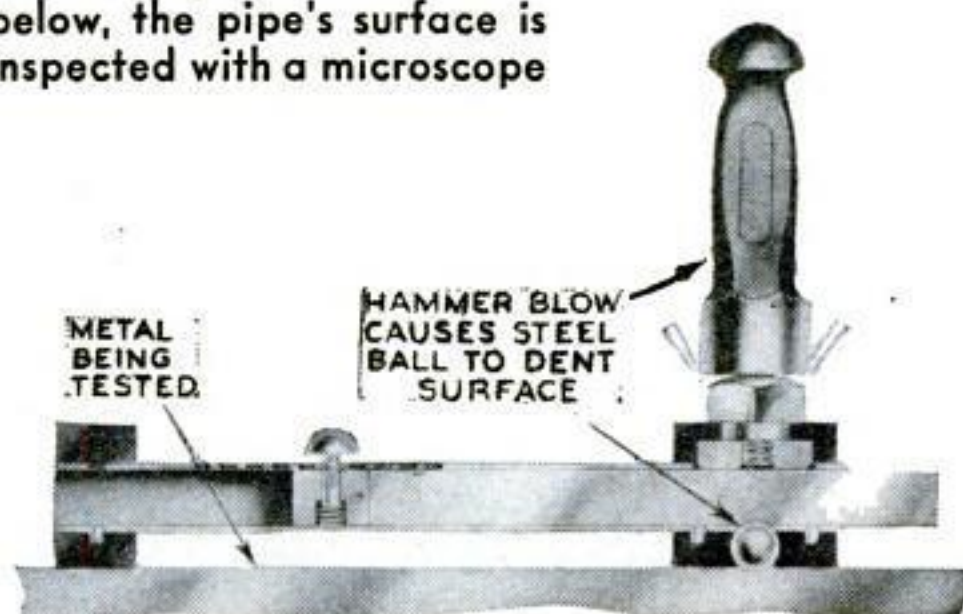
LIGHT in weight and portable, a new device for testing the hardness of metals eliminates the necessity of dismantling equipment and transporting specimens to a testing laboratory. The outfit consists of a metal bar of known hardness, a slide rule, a microscope with a transparent scale across its field of view, and other equipment. The microscope is used to measure and compare impressions made by a hammer blow in the test metal and in the bar of known hardness.



After using the tester shown below, the pipe's surface is inspected with a microscope



How the surface appears through the microscope. Note scale for measuring test dents



Handy File Box Holds Miniature Negatives

A FILE box for photograph negatives is a handy accessory for miniature-camera enthusiasts. Accommodating approximately 100 strips of four-exposure negatives, the file cabinet includes a set of transparent envelopes, index cards, and file guides. The transparent envelopes protect the films from dust, finger marks, and scratches, and make it unnecessary to remove the film strips in order to identify the negatives. Each index card is ruled to provide space for recording titles, dates, exposures, and other pertinent data concerning the negatives. Extra envelopes, file guides, and index cards are available.

Smoke Gets in His Eye —and the Pipe, Too

SMOKING a pipe with his eye is the odd accomplishment of Alfred Langevin, of Canada. Shown below with a pipe stem held close to his right eye by a nose clamp, Langevin sucks smoke through an opening at the corner of his eye, which, doctors believe, is caused by an enlarged opening in the duct that normally carries away tears. By closing his mouth and holding his nose, Langevin can inhale and exhale smoke through his eye with no ill effects.



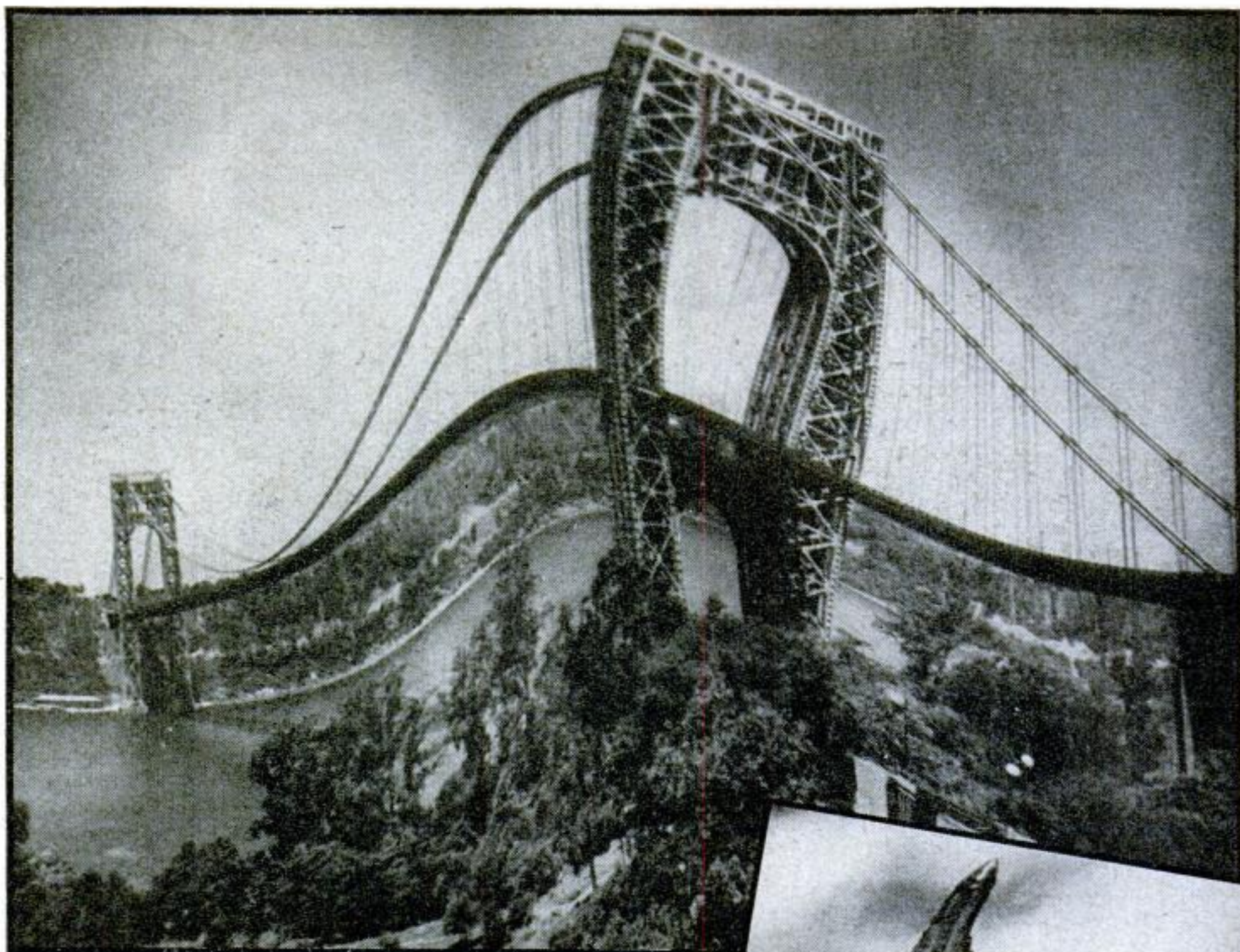
Alfred Langevin shows how he smokes through his eye. A nose clamp holds pipe

Students Make Model of Boulder Dam

STUDENTS in the engineering drawing class at Benjamin Franklin High School, Los Angeles, Calif., constructed the accurate scale model of Boulder Dam, pictured below. Requiring two years to complete, the model shows the dam in the process of construction, with contractors' machinery and equipment in place. No nails or brads were employed in the work.



Scale model of Boulder Dam constructed by the students of a California school



Lens Attachment Takes Weirid Photographs

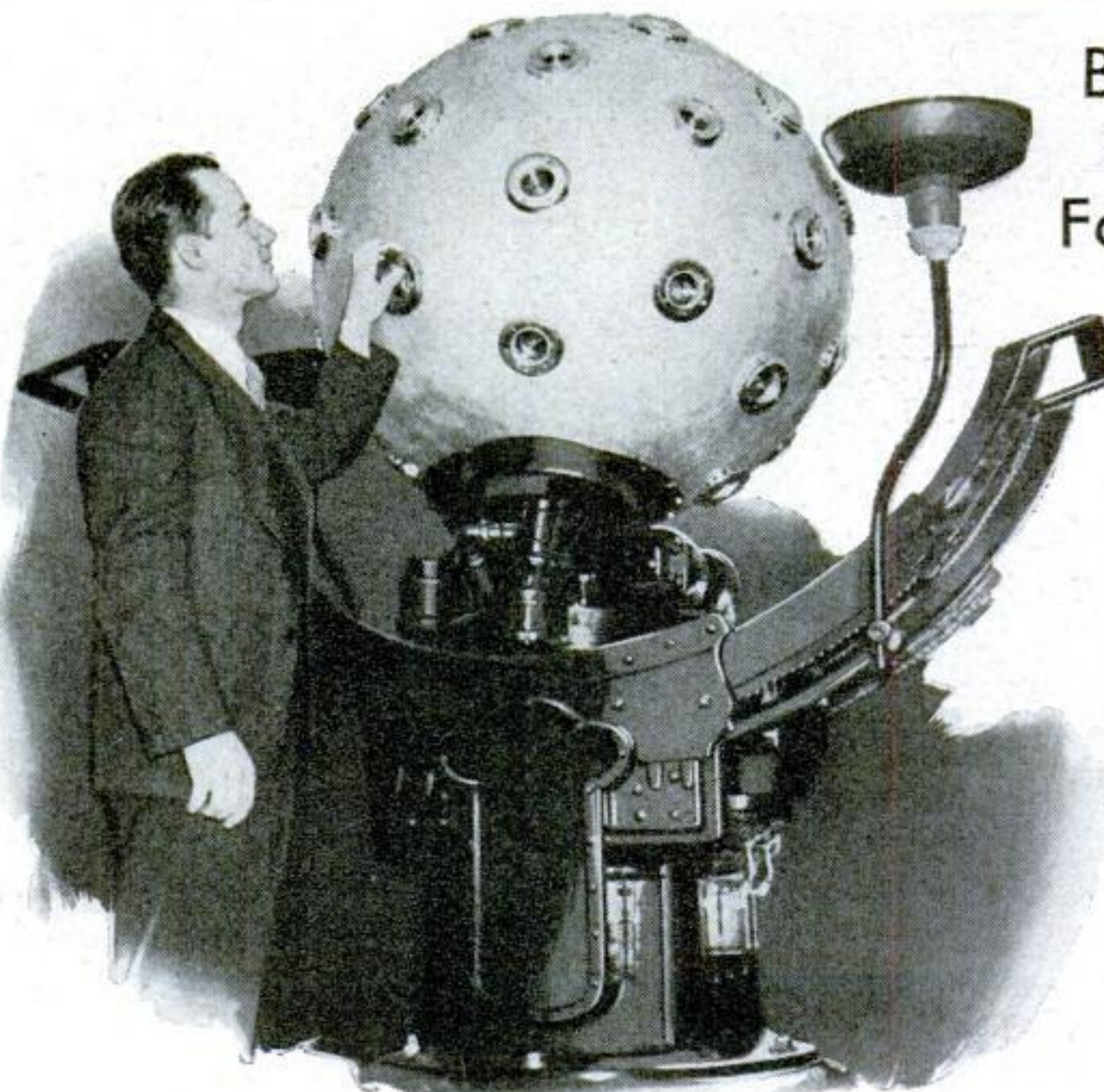
FANTASTIC photographs that show bridges twisted out of shape and buildings bent over at the top can be taken with the aid of a simple device invented by a New York City news photographer. The accessory consists of a wedge-shaped piece of optical glass that is pivoted in a holder fastened in front of the camera lens. By twisting the wedge of glass slightly, photographers can obtain shots that show the subject elongated, flattened, or twisted, like the reflections seen in the concave and convex mirrors found in many amusement parks.



Pictures of the George Washington Bridge and the Empire State Building in New York City made with the camera-lens attachment at left

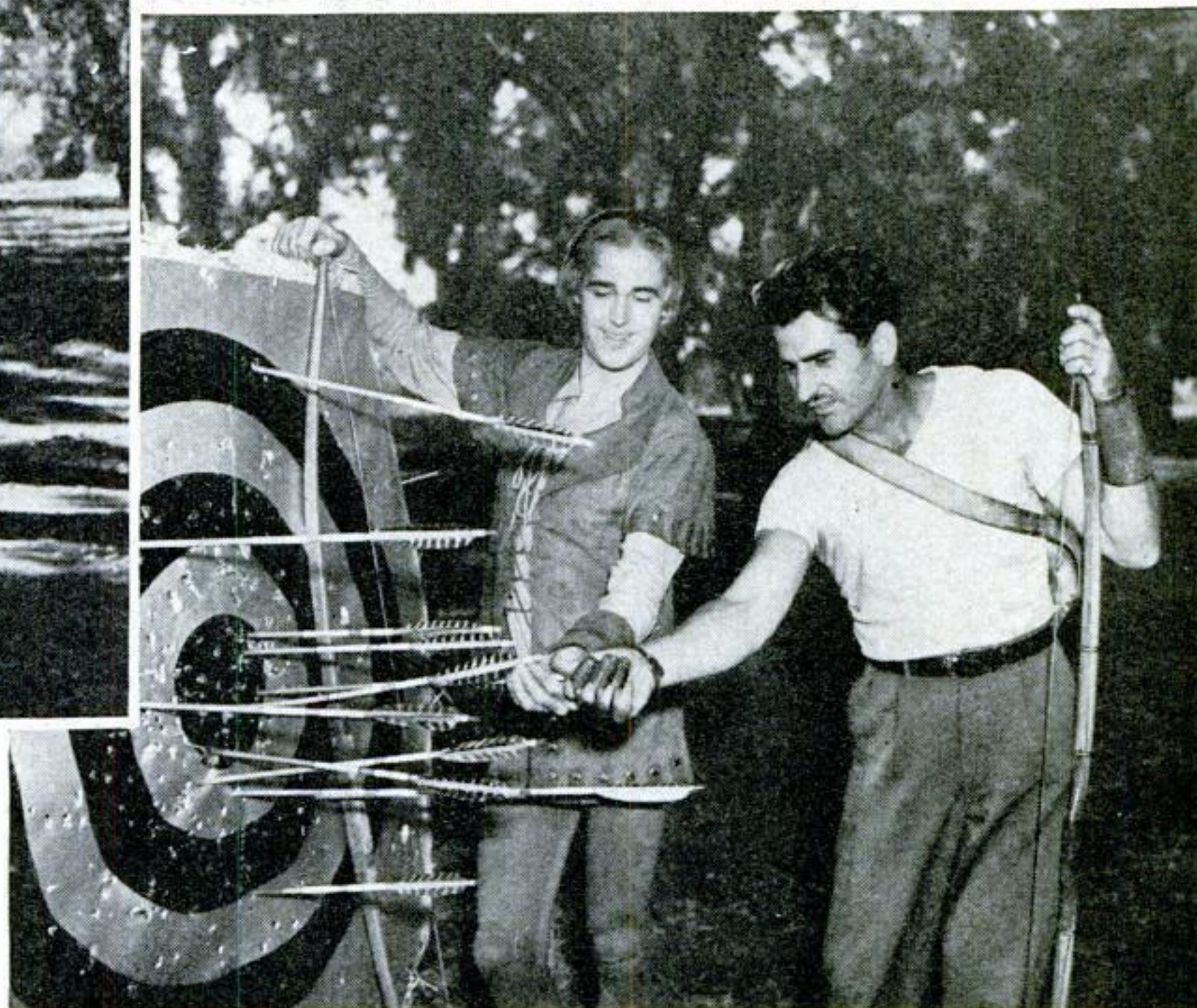
Builds Low-Cost Star Projector For Planetariums

A LOW-COST instrument for projecting "stars" on the domed ceilings of planetariums has been completed after three years' work by Frank D. Korosz, of the Springfield, Mass., Museum of Natural History. In contrast with the usual planetarium projector, the cost of which runs into six figures, the simplified instrument was built for \$12,000. The invention can be duplicated for small museums and colleges.





Present-Day Robin Hood Coaches Movie Archers



Howard Hill checking hits made by Patric Knowles, motion-picture actor, in training for a rôle in the new movie "The Adventures of Robin Hood"

SCREEN stars appearing in a film version of the story of Robin Hood, instead of having doubles appear for them in shooting scenes, learned the art of drawing the long bow from Howard Hill, famous archer who has hunted wild animals with bow and arrow (P.S.M., Dec. '35, p. 22). The photographs reproduced above and at the right show Hill giving Patric Knowles, screen player, some of the fine points of archery technique.



Siren and generator connected to sound an alarm

Portable Police Siren Gives Disaster Alarm

OPERATED by a portable generating unit mounted on a diminutive truck that is fitted with tiny pneumatic tires, an emergency siren developed by the Los Angeles, Calif., police department is used to warn residents of impending danger from fire, flood, landslides, and other disasters. The mobile unit has a small gasoline motor to drive the generator and so produce current for the electrically operated siren. The latter is placed within a metal sound reflector to broadcast the warning over a wide area. The assembly is pictured at the left.



Dog collar with detachable strip

Health Collar for Dogs Kills Ticks and Fleas

A NEW type of dog collar invented by Frank E. Vanderhoof of Old Greenwich, Conn., has changeable strips impregnated with a chemical as a preventive against fleas, ticks, and other animal vermin. One side of the treated strips has an adhesive for easy attachment.

Lighted Mirror for Motorists

AN ILLUMINATED vanity mirror for women motorists is a novel automobile accessory just marketed. Carried in a dash compartment or behind a seat, the unit has a flexible electric cord for connecting it with the car lighting system. Flipping a switch lights a small lamp concealed behind a lens at the base of the mirror to flood the user's face with a soft, diffused light while make-up is being applied.



A lamp attached to the mirror lights up the user's face

Thermometer Has Dial

HOUSED in a stainless-steel casing, the handy thermometer at the right records temperatures of liquids directly on a dial face attached to one end of the device.



Tail Spins To Order

... NOVEL TESTS CHECK NEW PLANES IN FLIGHT

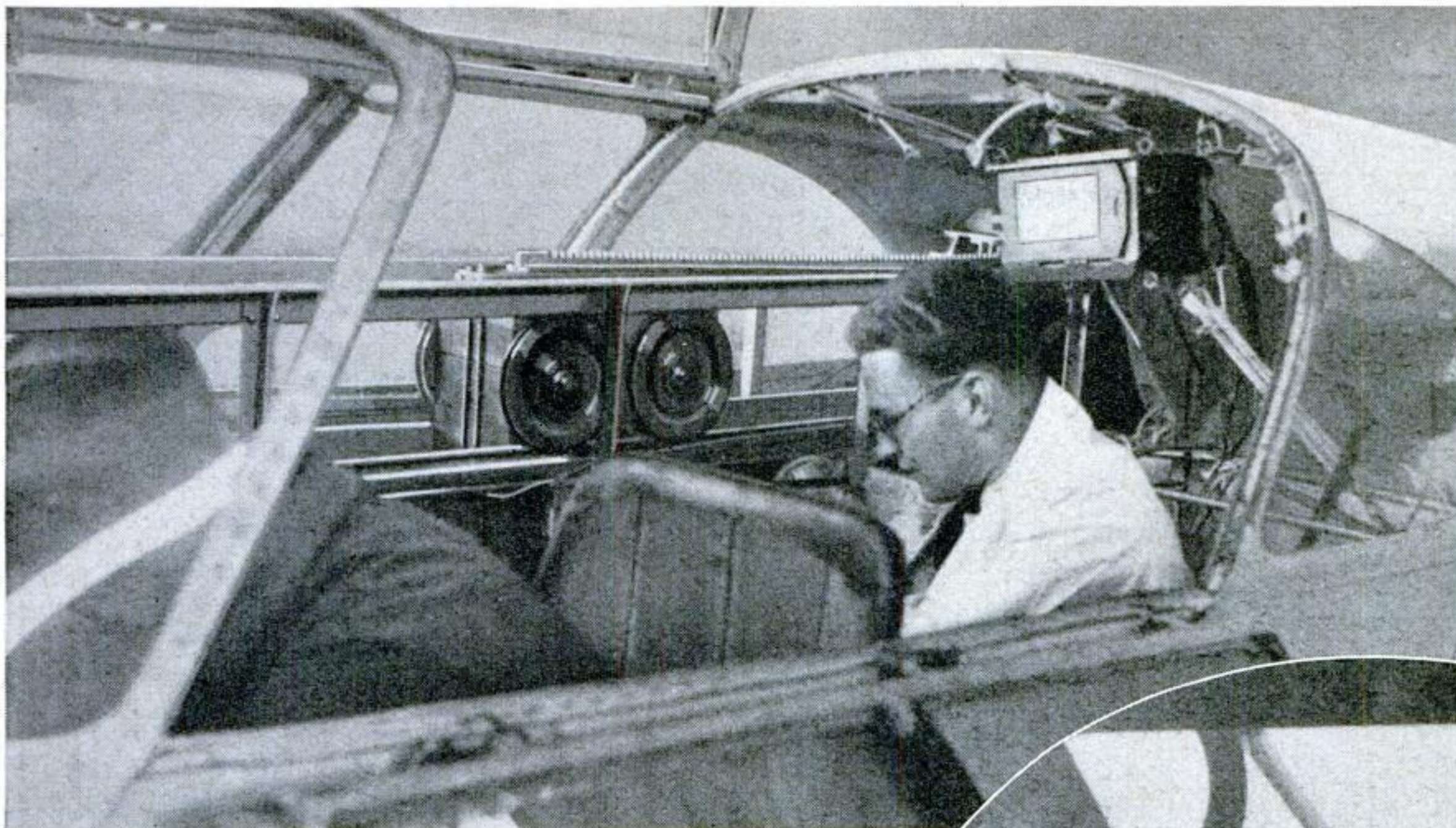
WHIRLING earthward in deliberate tail spins, airplanes guided by ace test pilots served as flying guinea pigs for German experts who recently conducted a novel group of aeronautical experiments at a Berlin airport. Employing two special motion-picture cameras, ingenious pressure gauges, and a clever little model that could be adjusted to imitate the exact position of the plane at any moment, engineers tackled the problem of exactly what happens to a plane as it falls dizzily in a spin.

Focused from the ground on a stunting plane, a high-speed movie camera fitted with a telescopic lens recorded every movement of the ship during the spin. Timed radio signals, automatically transmitted from the plane, actuated an electrical receiving instrument on the camera which in turn operated a light beam to make a mark on the edge of the moving strip of film. Thus the exact second when the plane appeared in any specific position in the air could be accurately determined by the identifying exposure marks on the margin of the developed film.

Within the plane itself, another movie camera was trained on a battery of U-shaped tubes partly filled with a special liquid that would photograph clearly. Each tube was connected by a rubber hose to one of a series of holes drilled in the wing, fuselage, and tail of the plane. As pressures varied on the outside surfaces, the liquids rose and fell in the tubes accordingly, and their movement was recorded on the camera film, together with time signals duplicating those registered by the ground camera. In this way, pictures of the air pressures on any part of the

1 Trained on a plane, this high-speed telescopic movie camera records its position at every instant

Strings of yarn attached to wing surfaces, photographed from inside the plane to show the effects of the air stream



By
**GROVER
C.
MUELLER**

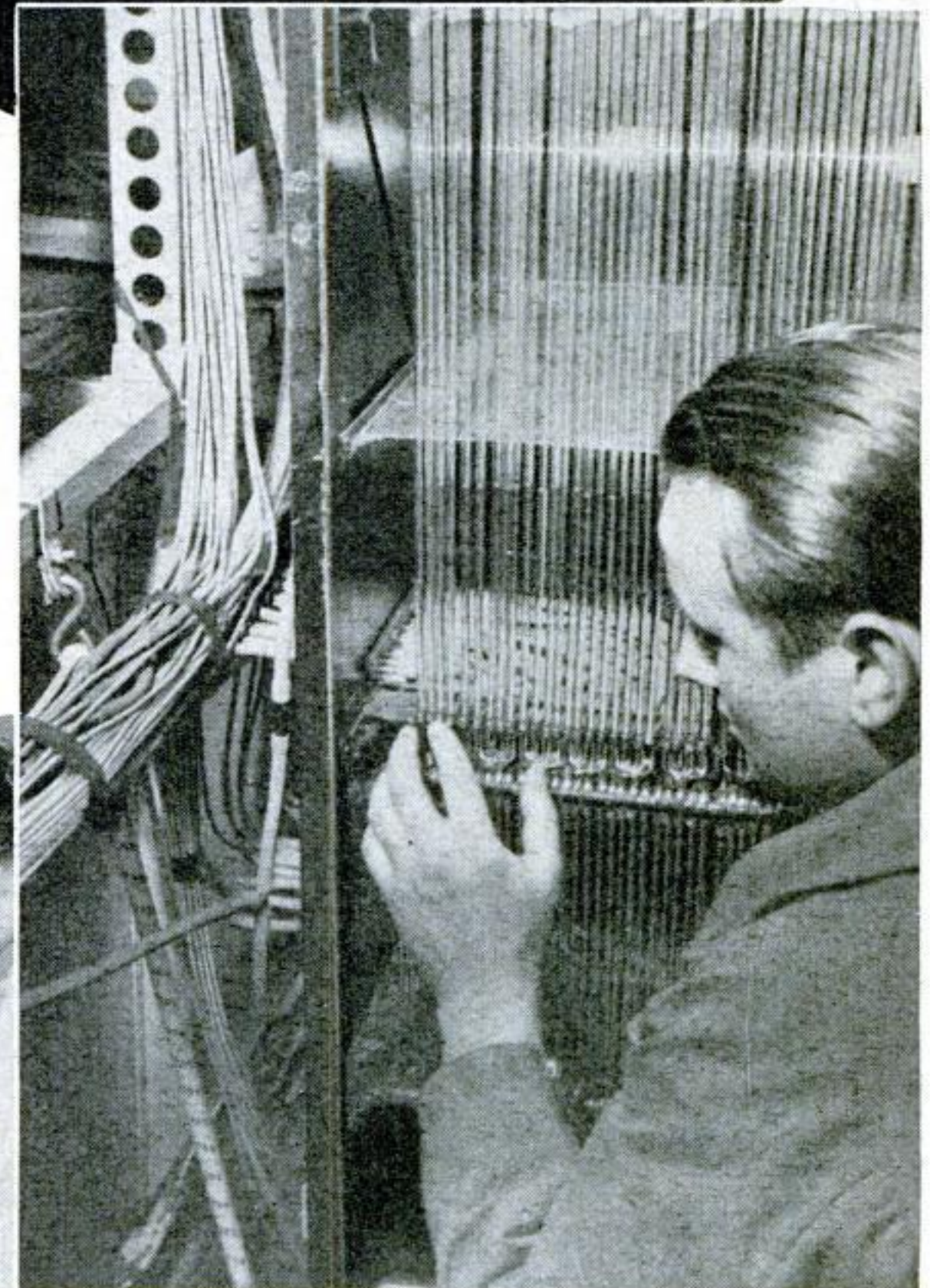
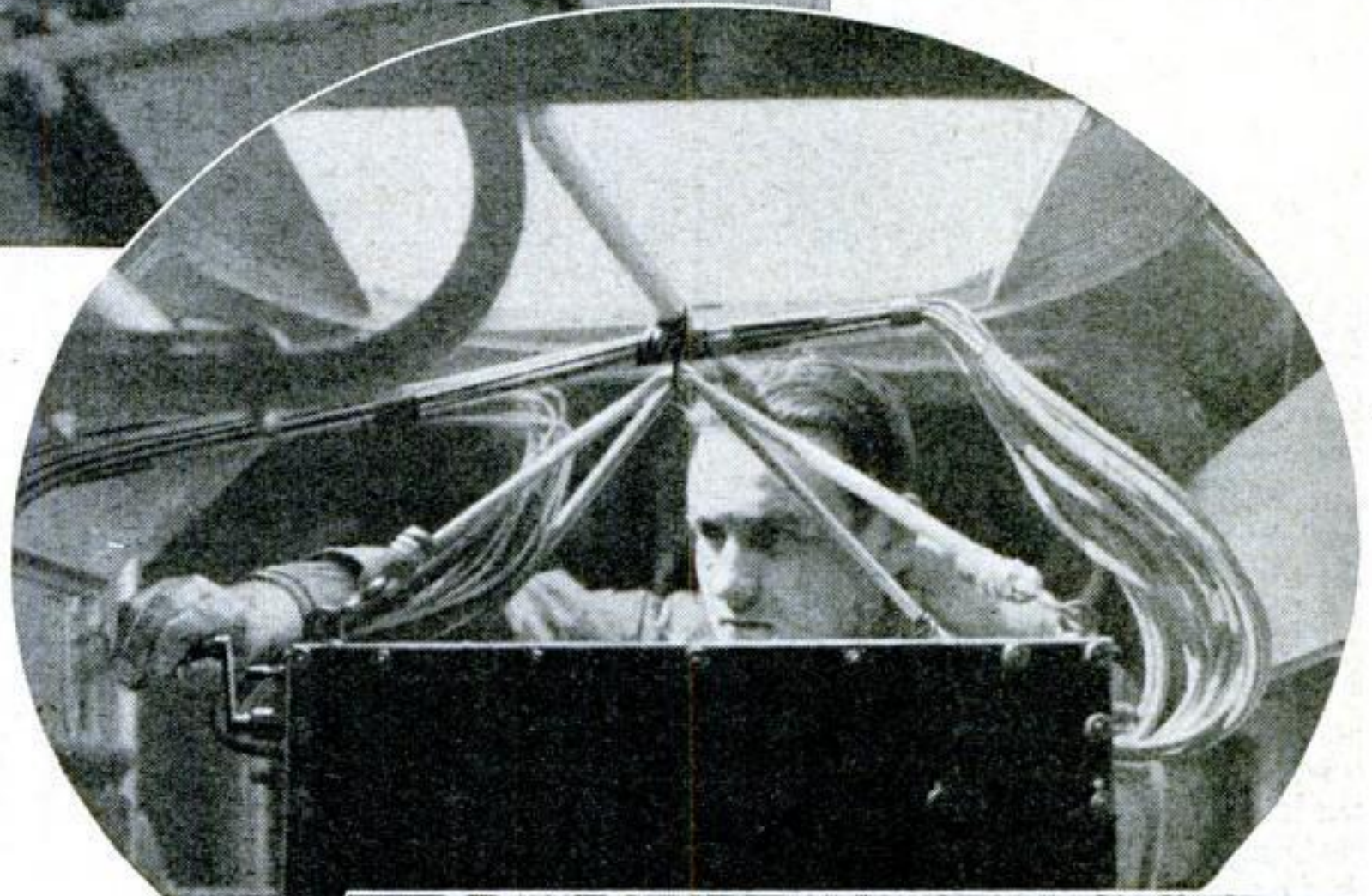
Plane fuselage fitted with a track on which a sliding weight can be adjusted to make the craft either nose-heavy or tail-heavy, enabling engineers to see how the plane will react

plane could be matched and compared with the pictures of its position in the air, as shown by the films taken through the telescopic lens.

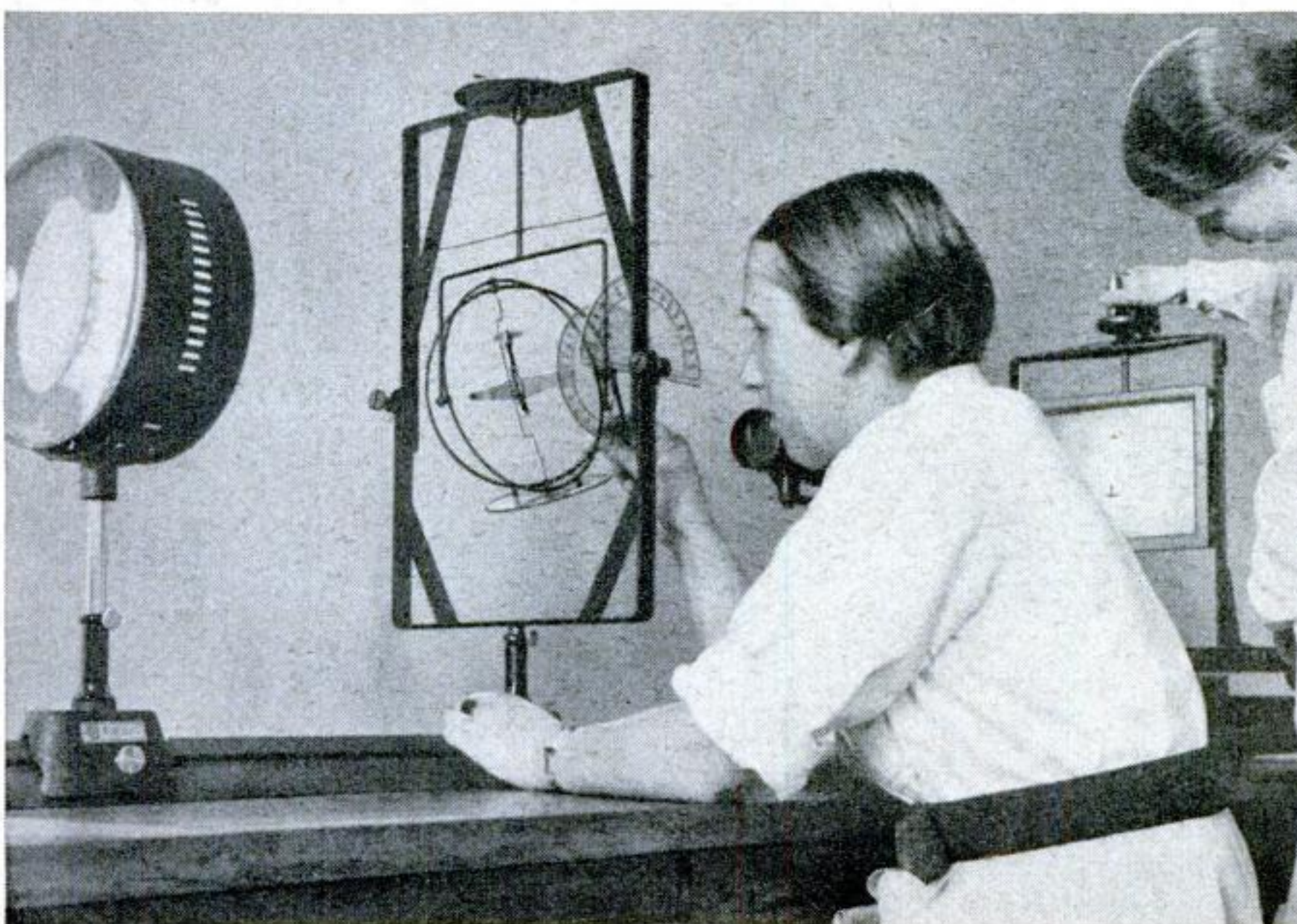
Back in the laboratory, still pictures from the developed films of the plane in flight were enlarged and thrown on a white viewing screen, one at a time. A diminutive model of the test ship, constructed to exact scale, was then suspended from an adjustable frame in front of a strong beam of light. To make it assume the precise position of the plane as pictured on the film, the model was moved back and forth until the outline of its shadow coincided exactly with the outline of the plane in the projected photograph. The relative horizontal and vertical position of the model was then compared with the corresponding air-pressure readings made by the plane's camera.

Another interesting experiment was made by training a camera from the cockpit of an open plane on strings of yarn attached to various points on the wing surface. When the film was developed, experts studied the effects of the air stream rushing past the wings by noting the movements of the strings as the plane went through different maneuvers. In still another test, the plane was deliberately put off balance by means of movable weights within the fuselage. This enabled the experimenters to determine, upon examination of the photographs, just how the ship reacted when nose-heavy and tail-heavy.

2 Inside the test plane, rubber tubes lead from holes in the fuselage and wings to the glass tubes at the right. The level of the liquid in each tube, as recorded on films, shows the air pressure



3 In the laboratory, the pictures of the spinning plane are thrown on a screen and a model is adjusted so that its shadow coincides with the outline of the plane in the photographs. This shows the position of the craft for each instrument recording



WHY

Here are a few of the most sleep, with the explanations

MYSTIFYING mankind for centuries, dreams still fascinate the psychologist. What causes them? How long do they last? How many dreams do we have in a night? Do men or women dream more vividly? What produces the familiar dreams of falling, flying, being chased by wild animals, and appearing unclothed in public?

During their long probing into the mysterious realm of the sleeping mind, scientists have discovered some simple explanations for such dreams as are illustrated on these pages. A physical stimulus—the pounding of the heart, the position of the bedclothes, the rhythmic movement of the respiratory muscles, a slight drop in blood pressure, the banging of a window shade—may give rise to the train of visions we call a dream.

In laboratory tests, subjects have dreamed of airplanes when an electric fan began whirring while they slept; they have visioned explosions when they smelled sulphur fumes from a burning match; they have dreamed of being licked by a shaggy dog when their hands were rubbed with wads of cotton; they have gone through imaginary lightning storms when a red light shone on their closed eyelids.

It is estimated that more than sixty percent of our dreams concern sights. Auditory dreams, connected with sounds, come next. Musicians, incidentally, experience them more frequently than any other class of people. Dreams of smells and tastes come near the bottom of the list. As a *(Continued on page 129)*

By **ROBERT E. MARTIN**

Many psychologists believe that the familiar dream of flying through the air is suggested by the rhythmic motion of the respiratory organs

Having part of the body chilled by being uncovered during sleep may produce the nightmare of being only partially clothed while in public

When you imagine yourself in the dentist's chair having a tooth pulled—and perhaps under very fantastic circumstances—the reason probably is that an unequal supply of blood to your teeth has started one of them aching, or that a small cavity is acting up. Feet tangled in the bedclothes may be responsible for the dream in which everything goes wrong and you finally miss a train

WE DREAM

common nightmares that visit our minds during given them by modern psychological experts

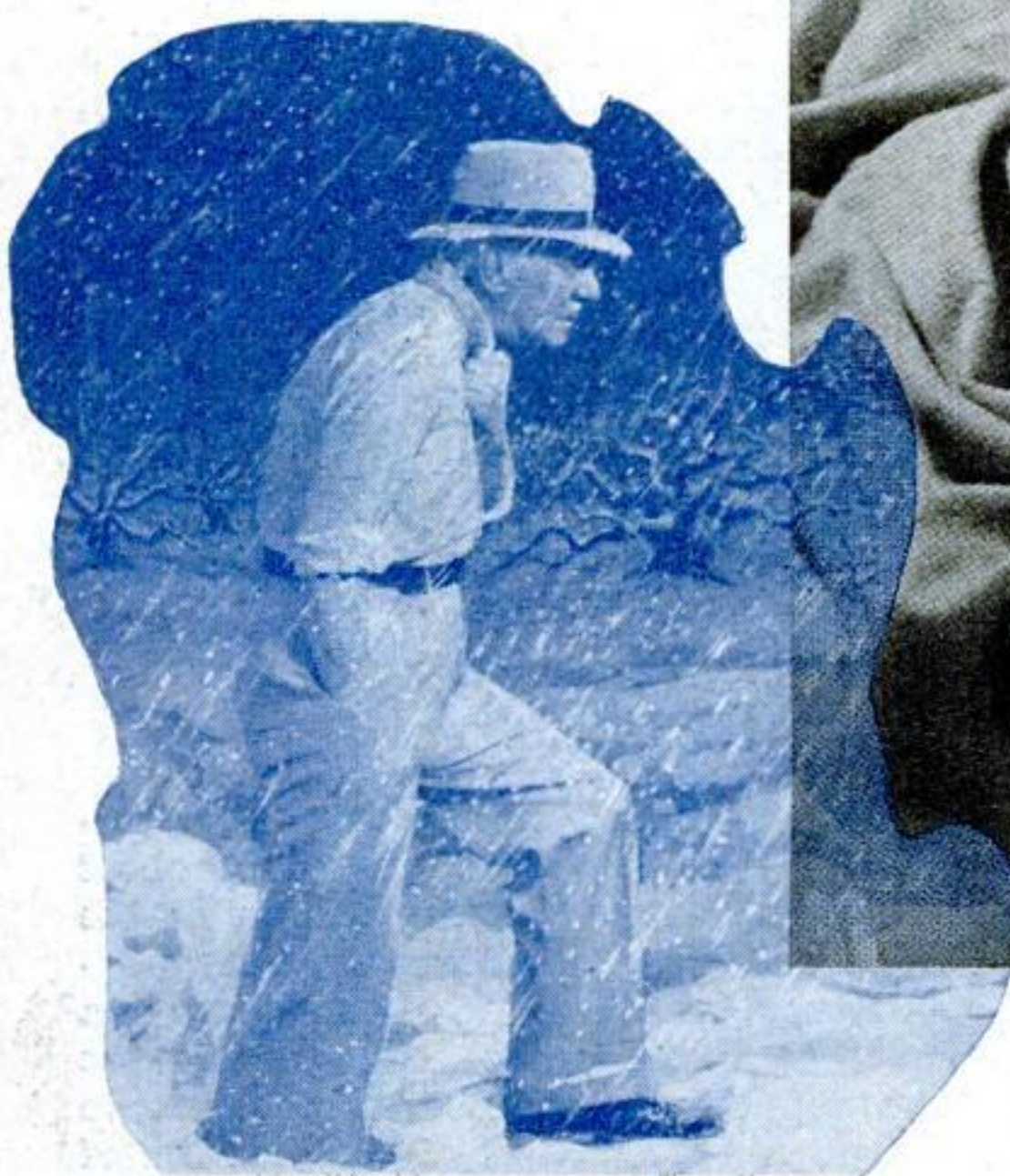
Murder nightmares like the one pictured at the right often are the result of heart or digestive disturbances



The terrifying dream of falling may arise from nothing more serious than a slight sagging of the bed. Being chased by a wild animal is explained by some psychologists as being caused by the subject having a subconscious fear of some person with whom he is unable to hold his own during the waking hours



Next time you dream that you are walking in a snowstorm or doing a little arctic exploring, you probably will find when you wake that your body has been chilled by having the covers slip off, or perhaps that you didn't have enough blankets to begin with



PLEASANT DREAMS? According to some experts, many of our weird visions of the night are the result of physical sensations that occur during sleep, which the mind tries to explain by inventing some amazing situation. To judge by his facial expression and bodily contortions, the man in this picture may be imagining himself in almost any one of the predicaments represented by the photographs on these pages



A mule having a tooth pulled. The animal was strapped to the table while standing up, and then brought to a reclining position as at right

DENTAL work and tooth extraction for mules, horses, and other large animals is made easier by the use of a tilting operating table. The animal, placed beside the table when the latter is in a vertical position, is strapped in place by means of bands around its belly

and padded strips that hold its hoofs in place. Turning a crank tilts the table to a horizontal position. Special clamps fitted to the animal's mouth keep its

"Dentist's Chair" for Horses Aids Veterinarians



jaws open and allow the veterinary surgeon to work in greater safety and with more efficiency than was possible under older methods.

Overhead Trolley Supports Giant Teapot



This apparatus will serve 150 cups of tea in ten minutes

SUSPENDED on wires from a trolley that moves along on an overhead track, a giant teapot speeds up the serving of the beverage in hotels and restaurants. Cups are arranged in rows inside the track frame, as shown in the photograph at the left, and the pot is moved into position over each cup as desired. The apparatus is said to enable caterers, hotel employees, and other food dispensers to pour more than 150 cups of tea in ten minutes.

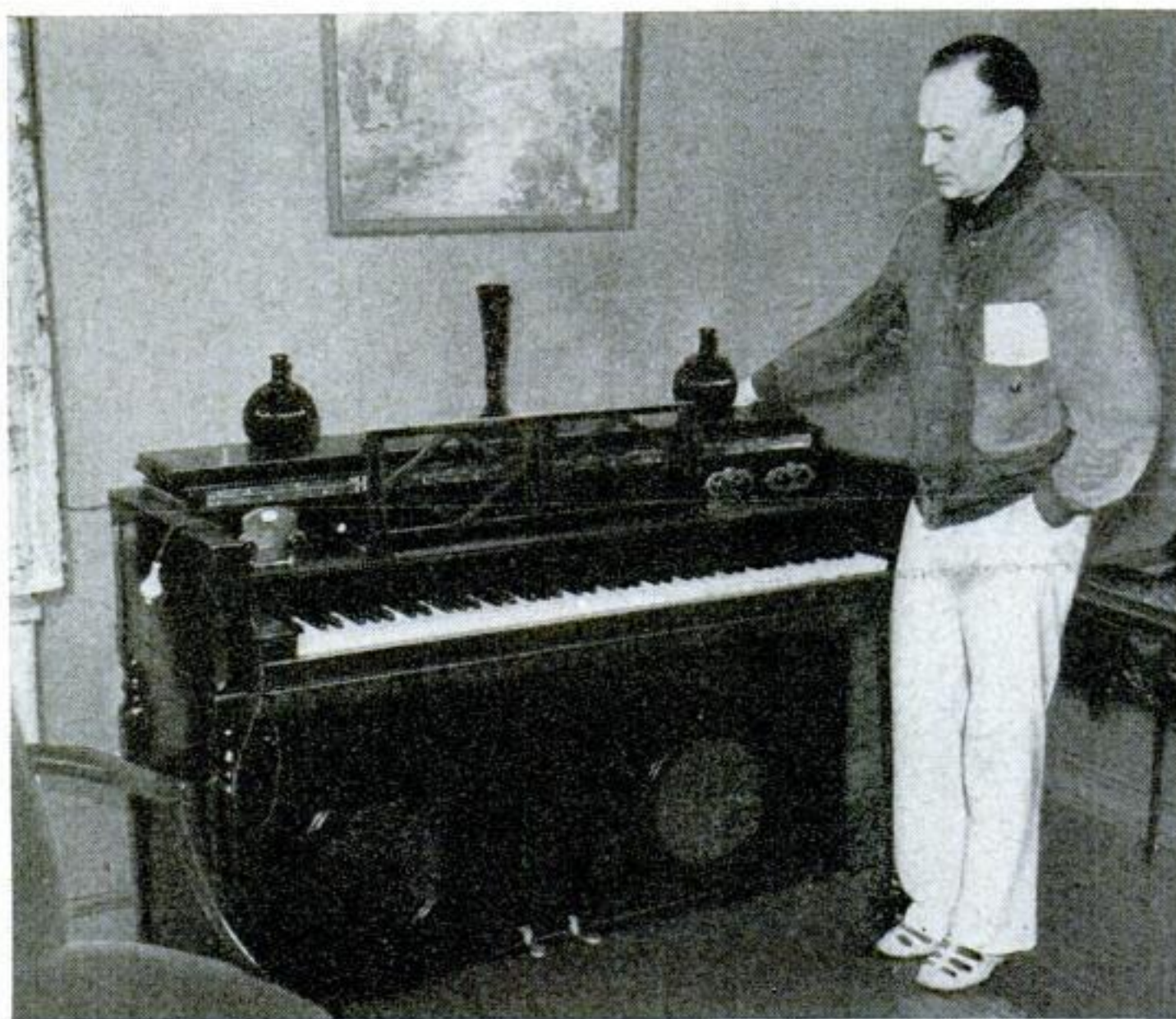


Raincoat Includes Hat

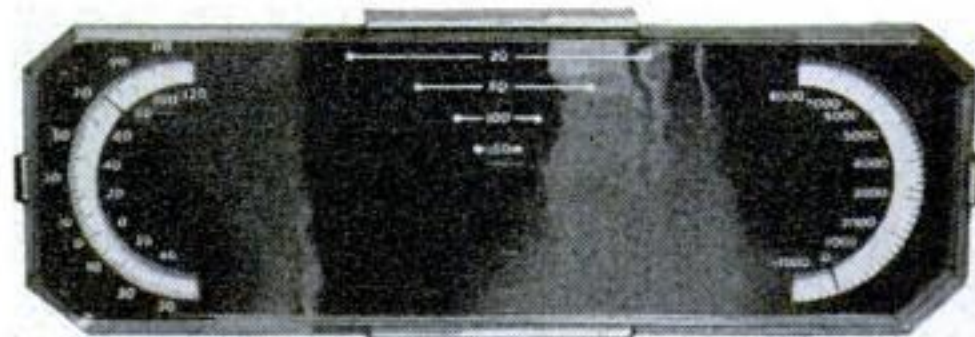
PROVIDED with a case which also serves as a hat, a new raincoat is flexible and thin enough to be carried in a coat pocket. Made specially for women, the coat comes in four colors.

Piano, Radio, Phonograph Combined

DESIGNED for use in small homes and apartments, a compact instrument just perfected by John Hays Hammond, Jr., noted inventor, combines a radio, phonograph, and piano in one unit. Loudspeakers mounted on the piano sounding board are said to provide unusual tone and volume for the reproduction of radio and recorded music.



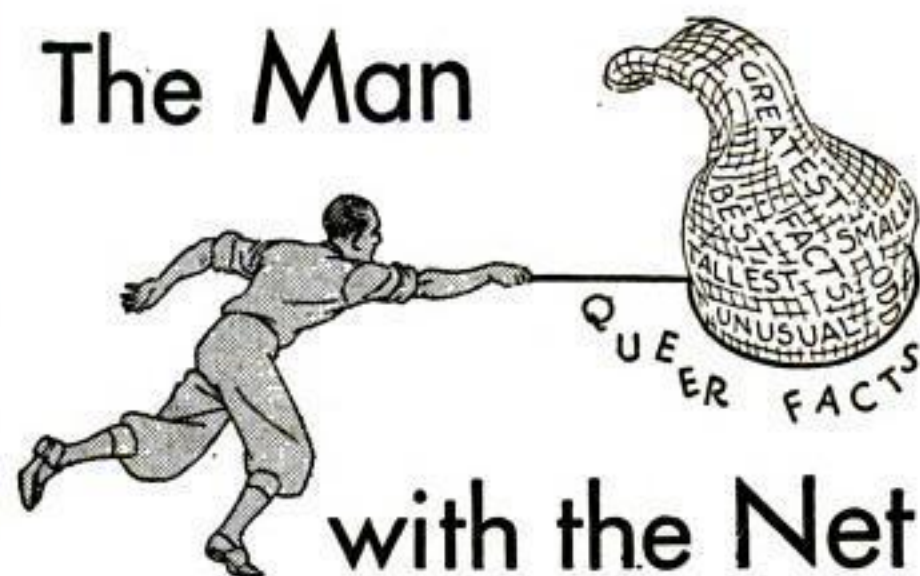
John Hays Hammond, Jr., with his piano-radio-phonograph



Car Mirror Measures Heat and Altitude

ALTIMETER, thermometer, and a distance gauge are built into the ends of a new rear-vision mirror now available to motorists. The altimeter automatically registers altitudes from below sea level up to 8,000 feet. Gauge lines at the top center of the mirror aid the driver in estimating the distances of following cars. The accessory is illustrated in the photograph above.

The Man



with the Net

PERENNIAL wheat which comes up year after year like asparagus is reported from a Russian laboratory.

CODFISH have three times as many bones in their skulls as humans.



CAST IRON three times as strong as any previously known is reported from England.

SHOES worn by city dwellers wear down at the heels sooner than those worn by country dwellers.

HARES leave less scent on the trail during the time they are raising young.



TEN THOUSAND sheep are being transported by air to remote government farms in Russia.

MEDICINES made from drug plants are affected by the time of day at which the plants are gathered.

GAS MASKS are given free with each life-insurance policy issued by a company in Rome, Italy.



PEACHES release more heat while in cold storage than pears or apples.

SIGNS in New York City could be read through the 200-inch Mount Palomar telescope by residents of San Francisco, if the earth were flat.

SKIN from an average man's body would make a sheet five and a half feet square.



Model Boats Race in New Electrical Game



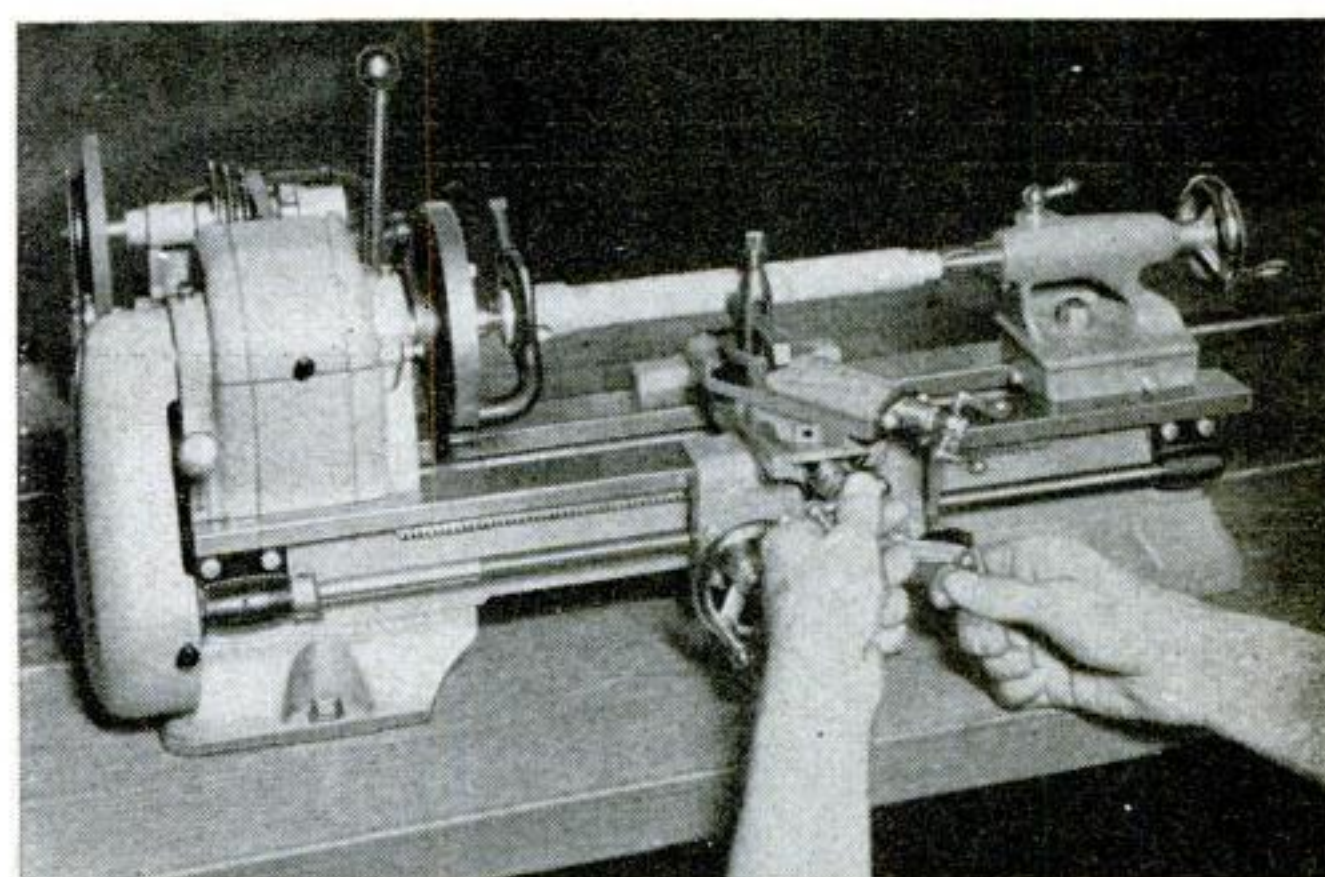
Vibrations cause toy boats to move along the model race course on this playing board

TINY model boats move over a board marked off as a race course in a novel electrical game just marketed. After boats have been lined up at the starting mark, the current is switched on and the base of the unit vibrates to

move the diminutive craft toward the finish line. Intensity of the vibrations can be regulated to accelerate or slow down the boats' speed. Current is supplied through a connecting cord plugged into an electric outlet.

Home-Workshop Fans Get Small Metal Lathe

DESIGNED for metal-working enthusiasts, a small metal lathe has many of the features of an industrial machine tool, scaled down for the machining of small work. Turning work up to six inches in diameter, the lathe is made in two sizes, one accommodating work twelve inches and the other eighteen inches between working centers. The tool has sixteen speeds, V-belt drive, and roller spindle bearings.



The lathe in use. It turns work up to six inches in diameter

Spring Clamps Hold Spurs on Riding Boots



William Seyfarth, of Phoenix, Ariz., demonstrating his easily detachable spurs

SPURS invented by William Seyfarth of Phoenix, Ariz., are fitted with built-in springs that clamp on the heels of riding boots so that they may be quickly attached or removed. So simple was his idea that Seyfarth feared it would not be patentable. However, after application, he was granted the first patent on an invention of this type to be issued by the U.S. Government in thirty-one years.

Dust Mask for Home Use

A CONVENIENT and inexpensive mask now on the market is handy for the home owner in removing ashes and performing other work in which dust causes discomfort. The lightweight mask, pictured at the right, is also useful in the home workshop to avoid dust while grinding, sanding, or buffing.





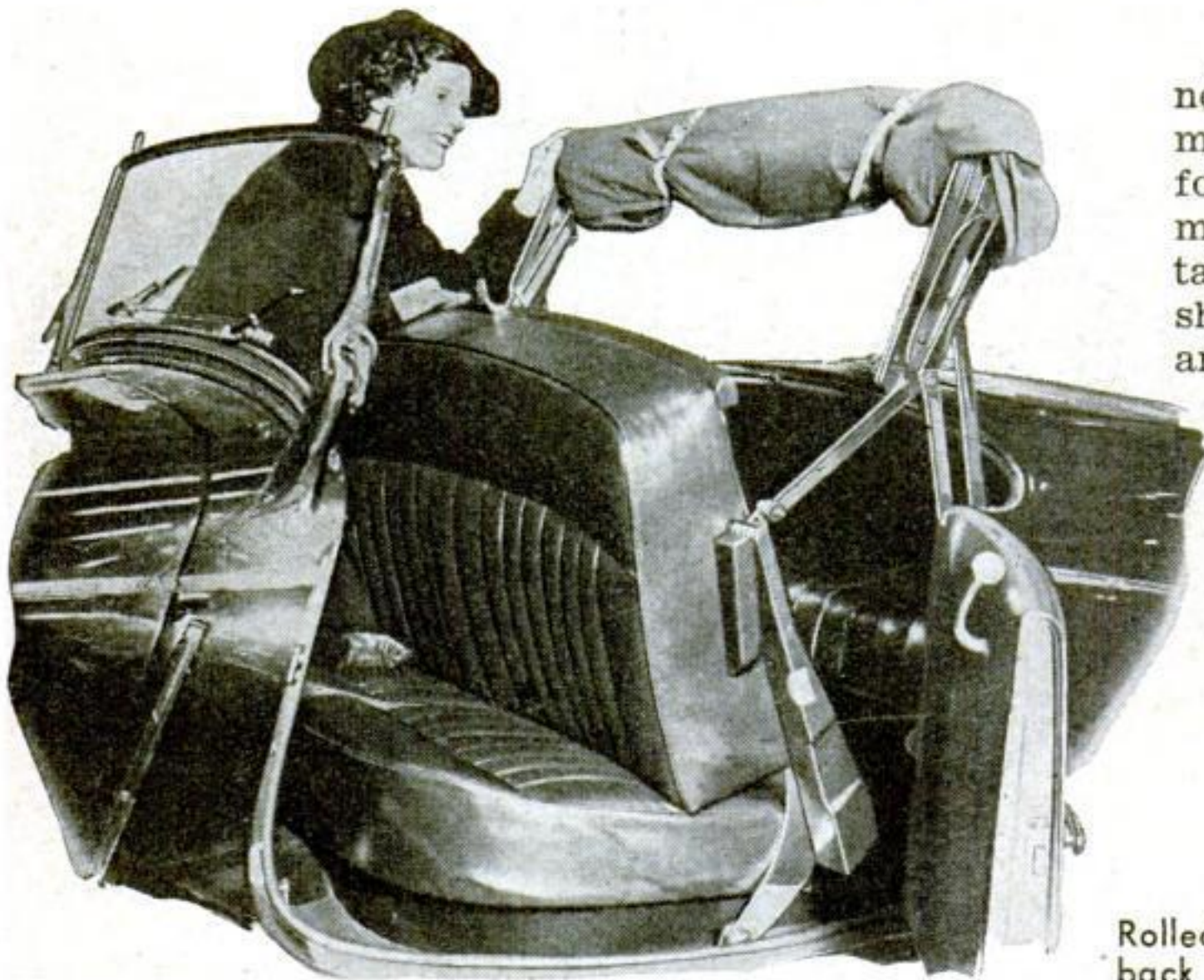
Scrubbing brushes form the surface of this novel ski slide. They are laid with bristles up, as illustrated at the right

Brushes Replace Snow on Ski Slide



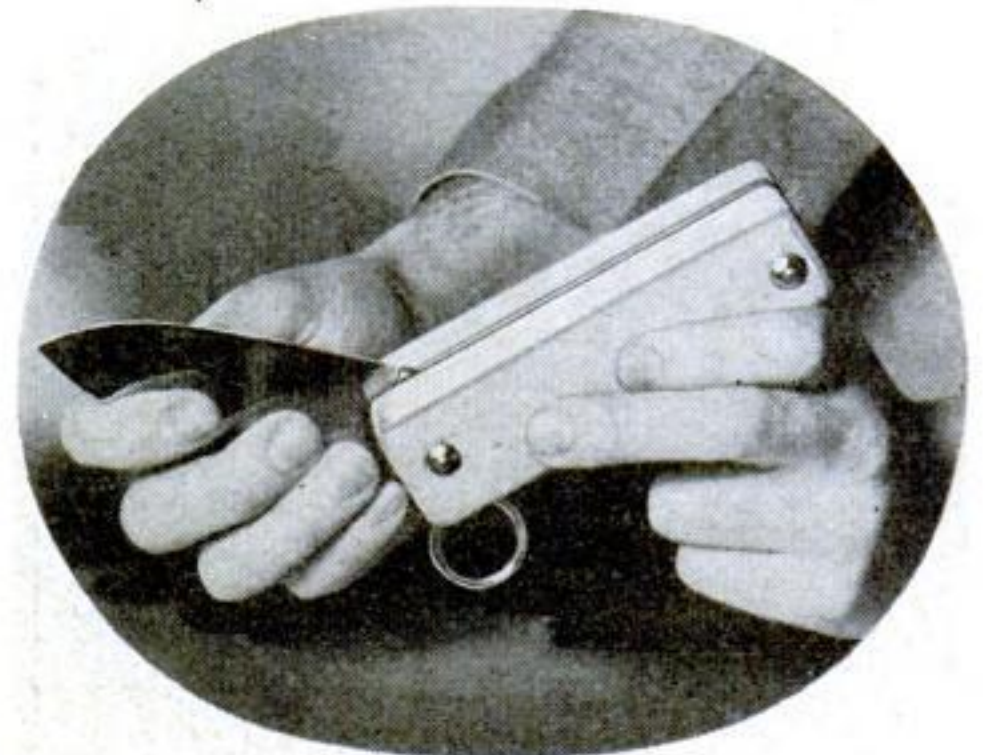
BRUSHES take the place of snow on a novel indoor ski slide recently opened to patrons of a sports arena in Germany. Thousands of long-bristle scrubbing brushes without handles were laid next to each other on the surface of the slide and nailed down with their bristles extending upward. The resulting surface is said to be almost perfect for skiing, the bristles being just elastic enough to allow skis to glide over them smoothly. Instead of a long spike, ski poles used on the novel slide have circular brushes on the ends to provide a nonskid contact with the brush floor for use in climbing and turning.

Roadster Has Vanishing Top



A DISAPPEARING top is a novel feature on a new model of a roadster of foreign make now on the market. When it is detached from the windshield, the top is rolled and strapped to its supporting arms. The car seat is then moved forward and the top lowered into the space behind by means of a special hinge arrangement of the top supports, as shown in the photograph at the left.

Rolled up, the top folds back behind the car seat

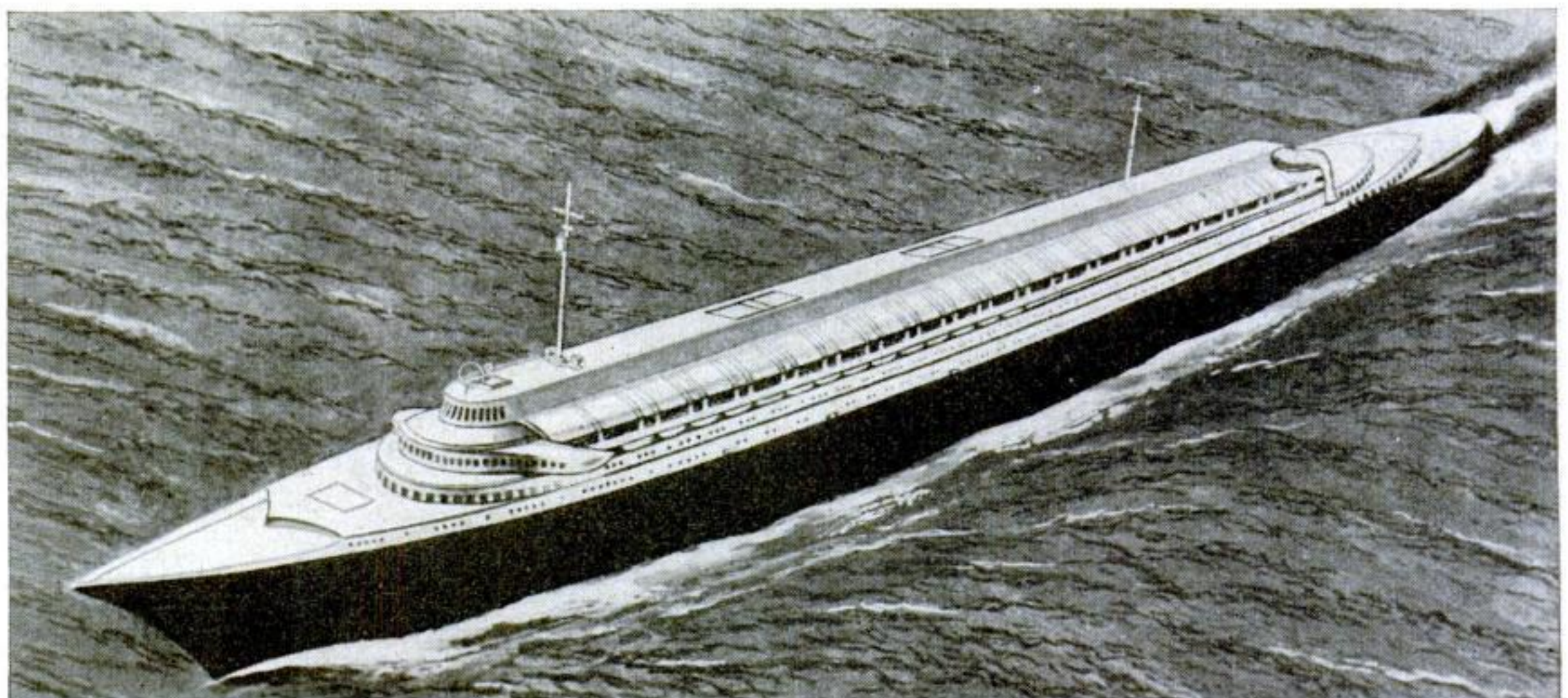


Knife for Yachtsmen Floats in Water

CORK sides on a novel knife for yachtsmen keep it from sinking if accidentally dropped overboard. The blade of the floating knife has a lock to hold it in position when open, preventing it from snapping shut when in use.

Huge Streamline Ship To Cut Time for Ocean Crossing

SLICING through the water at thirty-seven knots an hour, a streamline ocean liner proposed by French ship owners would cut down the time of a transatlantic passage to three and a half days. Plans call for a vessel more than 100 feet longer than the height of the tallest skyscraper, and more than 300 feet longer than the largest vessel afloat. The preliminary sketch reproduced at the right shows some of the proposed streamline details. The concealment of funnels is an outstanding feature. Sliding glass roofs will cover the upper decks of the ship.



Preliminary sketch of a proposed streamline ocean liner. Smoke is discharged through vents at the stern

Rifle Barrel Becomes Bugle for Musical Stunt



The musical rifle is played by blowing through it as if it were a bugle

USING the barrel for a horn, an English musician can play bugle calls on a rifle. A trumpet mouth-piece is inserted into the muzzle and the bolt removed. The notes produced are shrill and piercing, but are said to be perfect in both tone and pitch. The originator of the idea is shown in the photograph reproduced at the left holding the novel instrument in the correct position for sounding a bugle call.



Man's Legs Serve as Identification Card

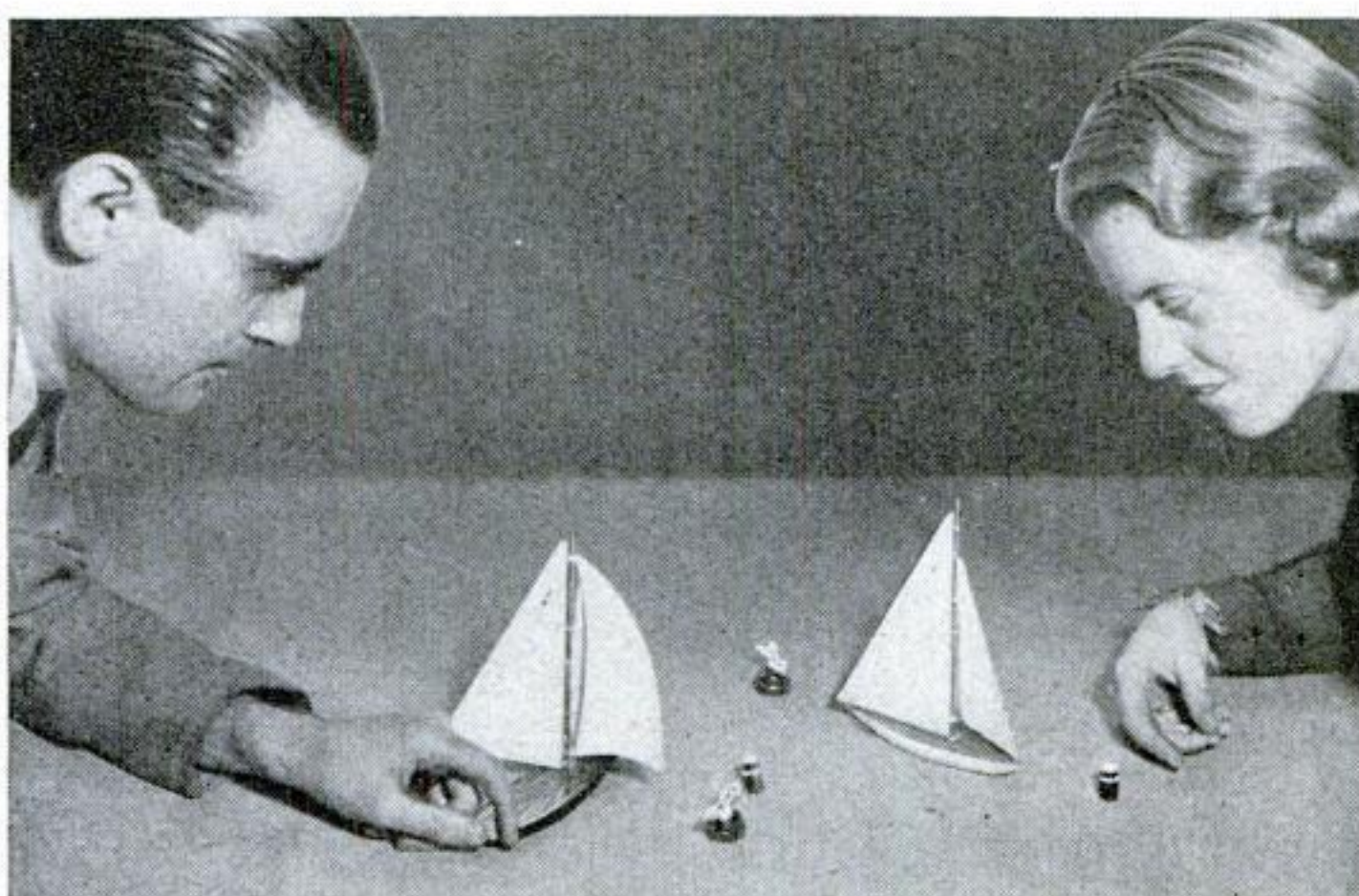
THEODOSIUS D. ROCKWELL, of Portland, Ore., whose face is shown above and whose legs are shown below, says that he isn't afraid of amnesia, or loss of memory. His legs are tattooed with his telephone and social security numbers, and with his name and address in forty different languages.



Wherever he goes, his legs will lead him home

Model Boats and Buoys Teach Sailing Rules

FITTED with adjustable metal sails and removable spinners, tiny models of Class J boats in a kit just placed on the market aid in teaching beginners the rudiments of sailing. Adjustments to be made in the sails and tiller for various winds and desired directions are marked on the deck of each boat. Colored buoys and wind and tide indicators complete the outfit.



Learning fundamentals of tacking and "coming about" with the toys

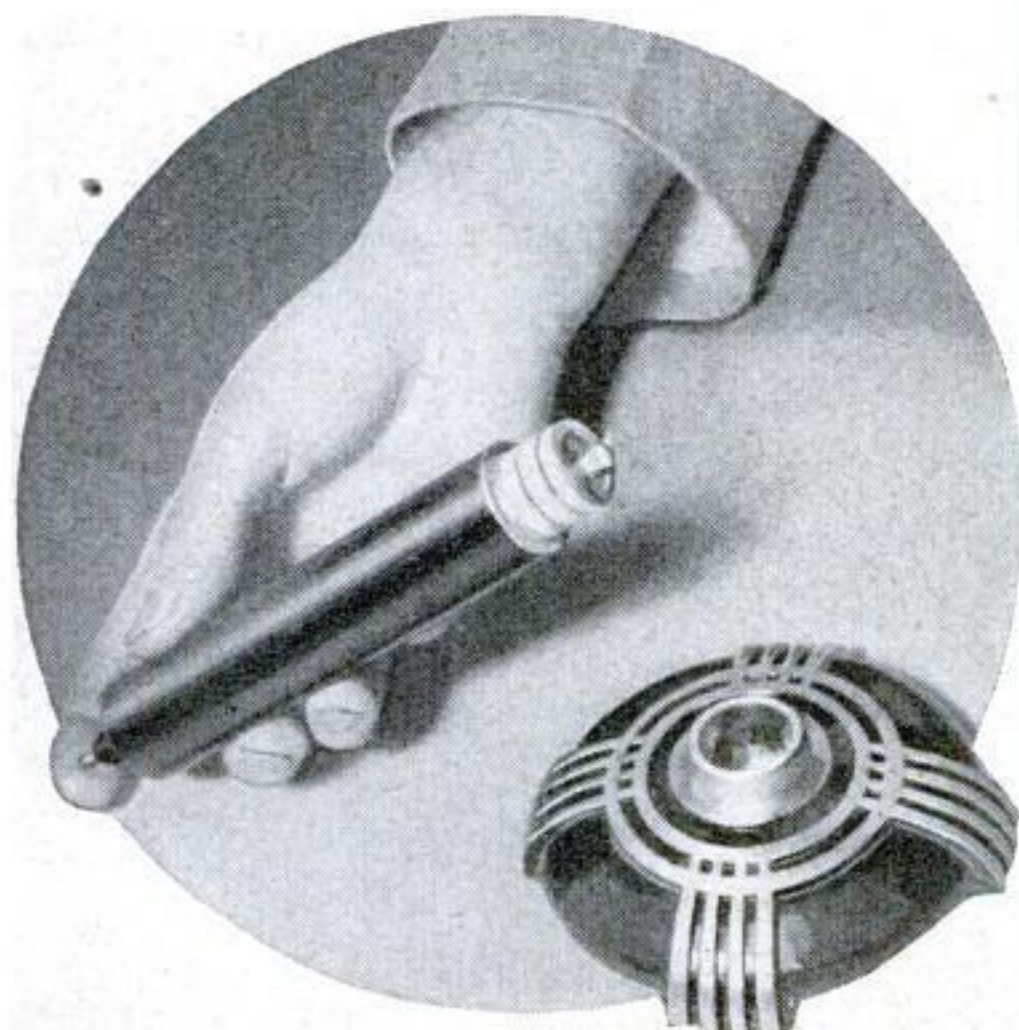
Fireless Tobacco Pipe

SMOKE without fire is possible in a new pipe for smokers. An electric heater raises the temperature of the tobacco sufficiently to produce aromatic vapors, but not enough to make it burn.

New Military Road Has Rail To Guide Trailers

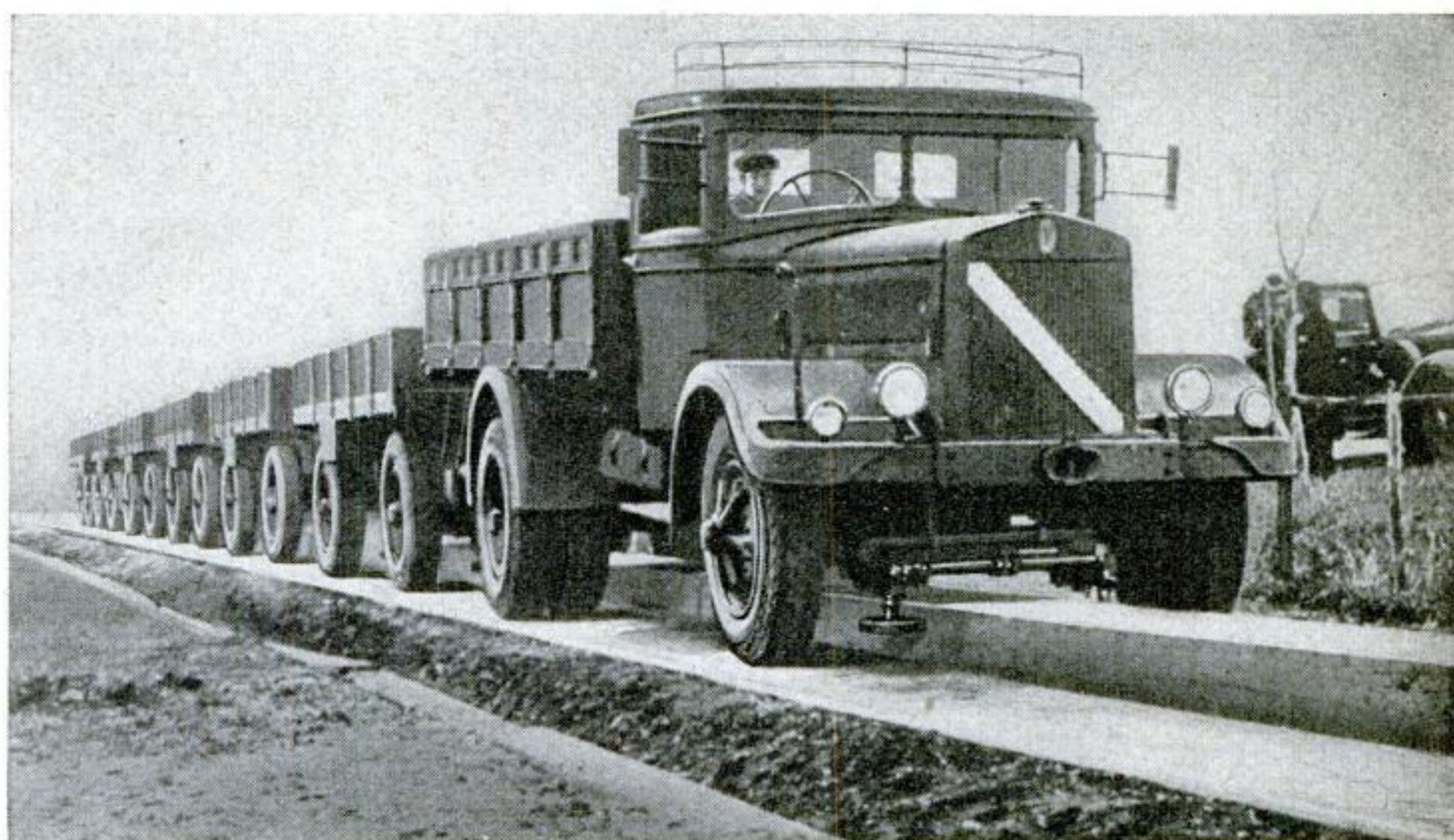
BUILT as an experiment near Rome by Italian army authorities, a new type of military road has a raised concrete projection running down the middle of it, as pictured below. By means of the

special ramp, one truck can haul a number of trailers full of military equipment. Guide rods which fit as flanges on either side of the ramp keep the trailers in line, even on curves.



Electric Cigar Lighter Looks Like a Candle

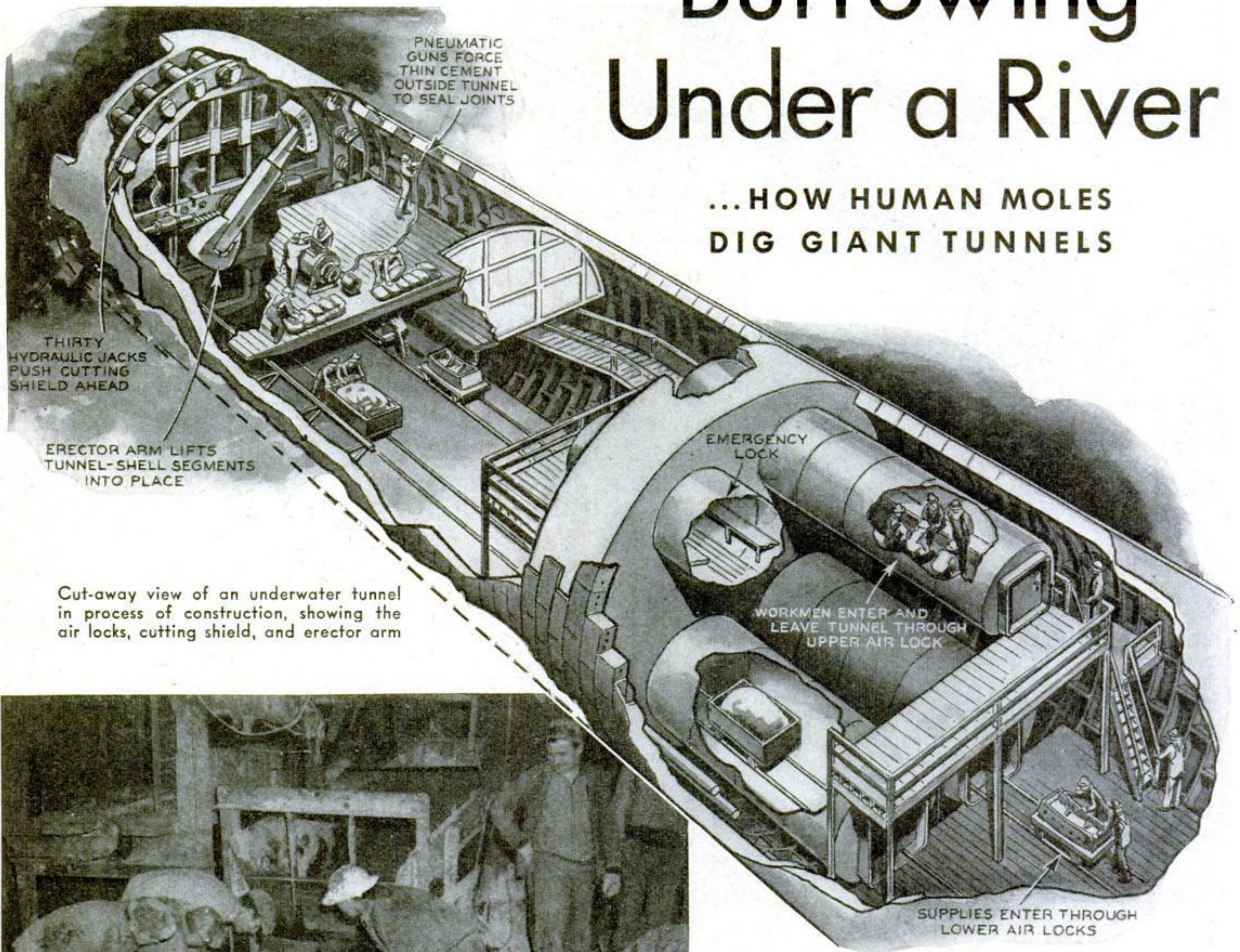
JUST made available, a cigar lighter is designed to resemble a wax candle. Two flash-light cells are housed within its stem. When the lighter is lifted from its base and its pointed tip pressed, a spark ignites the wick. Replacing it extinguishes the flame.



The concrete rail permits one truck to pull a train of six military trailers along the road

Burrowing Under a River

...HOW HUMAN MOLES DIG GIANT TUNNELS



Cut-away view of an underwater tunnel in process of construction, showing the air locks, cutting shield, and erector arm

By ARTHUR A. STUART

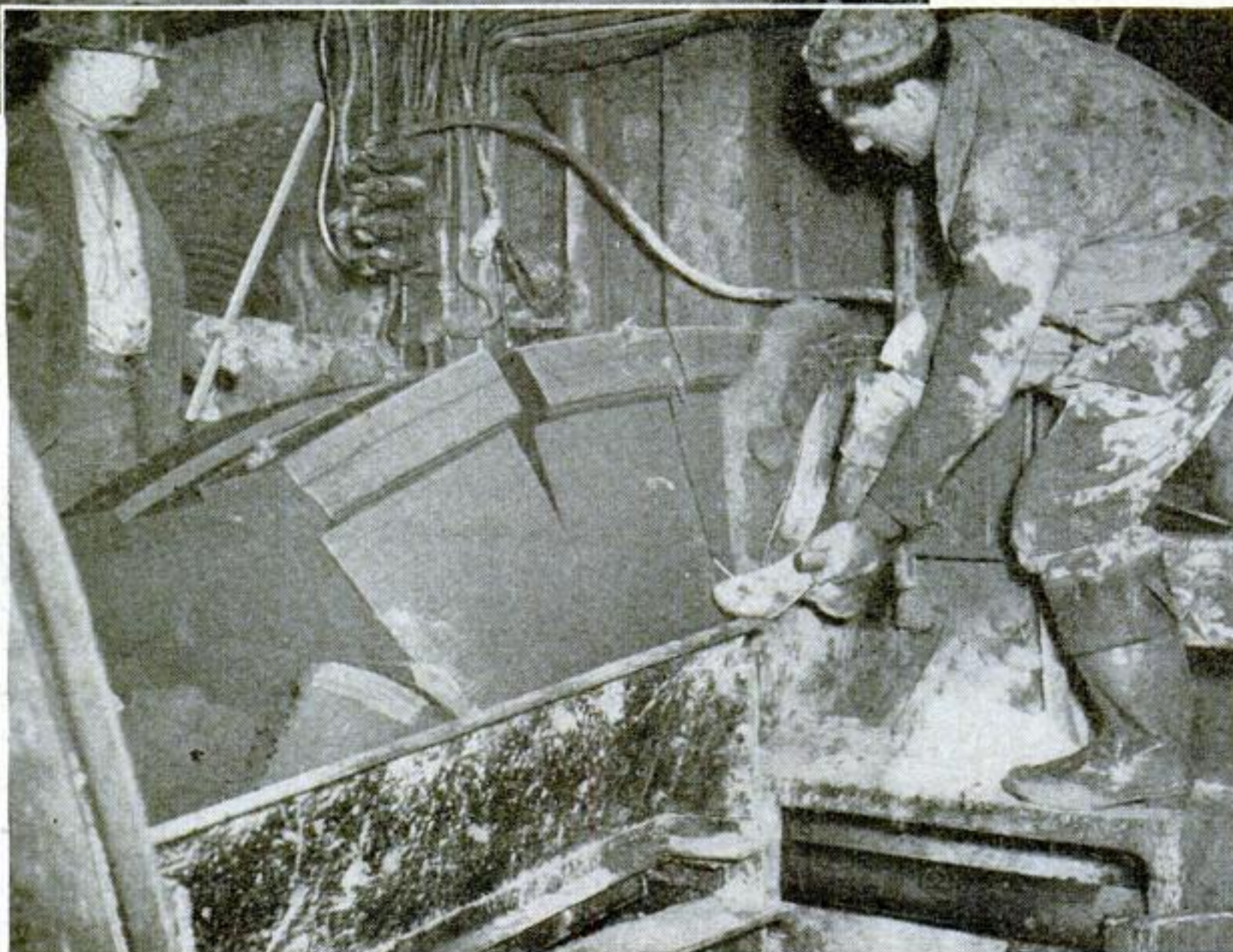
WHILE bands blared and Army airplanes droned overhead, a few weeks ago, Governor Herbert H. Lehman of New York and Governor Harold G. Hoffman of New Jersey dedicated the first tube of the new Lincoln Tunnel under the Hudson River. Like an immense angworm of metal, with more than 3,000 segments in its 1½-mile-long body, it links midtown New York City with Weehawken, N. J. Fifteen million cars a year, more than a million a month, are expected to stream through the new tube and its twin, to be completed three years hence.

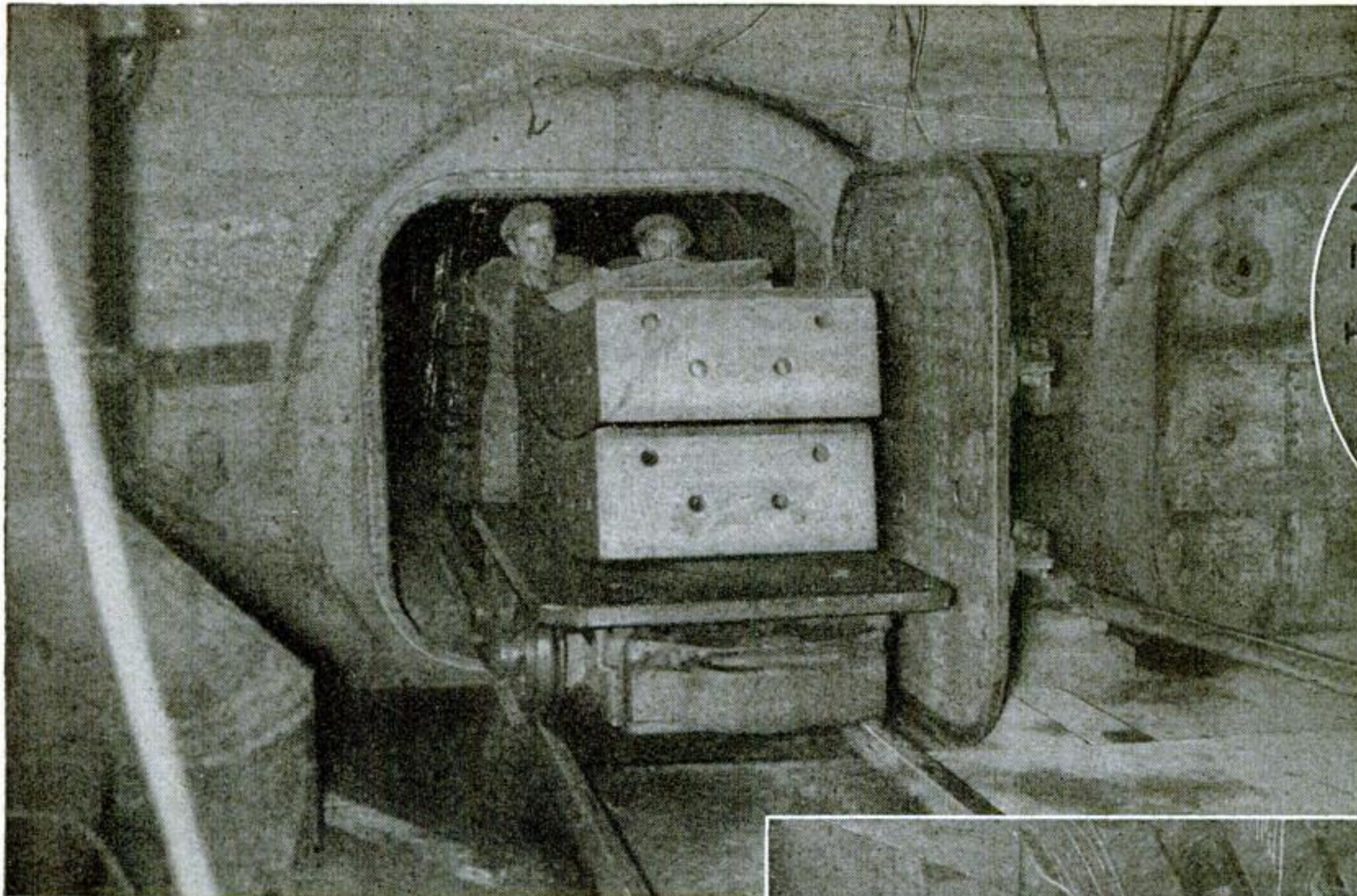
Forty tunnels now burrow through mud and silt to carry automobiles and trains beneath the rivers which make an island of Manhattan, the heart of New York City. Nine of these tubes cross the Hudson, while the others link Manhattan with Long Island, on the other side of the East River, and with the mainland of New York State. The men whose lives of danger and daring make these tubes possible are the sand-hogs, workers who labor in



Clay sliced out of the river bottom is spread upon the floor of the tube to serve as ballast. These workers are taking the chunks off a conveyor belt

Sandhogs slicing the clay into big chunks as it pours backward from the crown shield. It is cut like cheese by drawing wires downward across it





Badges like this are worn by all compressed-air workers when they are off duty, to insure proper care if attacked by "the bends"

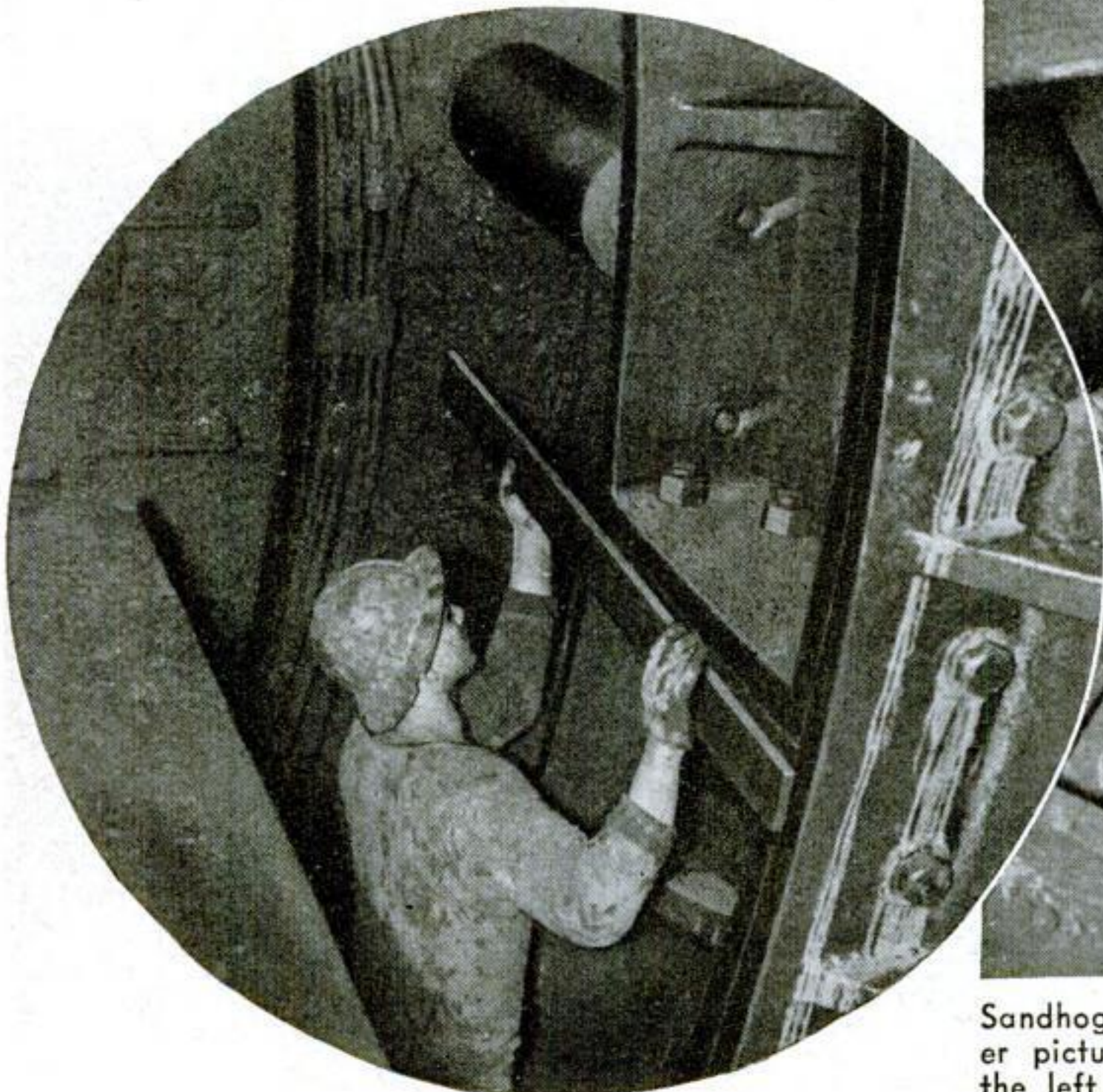
A hand car loaded with materials being pushed out of an air lock into the tunnel workings. All men and equipment must pass through these compression chambers

compressed air far down below mighty rivers.

At the moment when distinguished visitors and state officials were dedicating the Lincoln Tunnel, sandhogs, seventy-five feet to the north, were driving ahead through silt and clay, rushing to complete the second tube. The lives of these human moles depend upon the invisible factor of air pressure. For such underwater tunnels are not blasted through rock nor dug by hand. They are produced by "shoving blind" through the ooze of the river bed. A crown shield, shaped like a giant cookie cutter and weighing nearly 400 tons, is forced ahead, a few feet at a time, by a battery of hydraulic jacks capable of exerting a push of 12,000,000 pounds. The air pressure, varied within the chamber of the advancing tube according to the depth of the river overhead, holds out the



Sandhogs bolting together the metal segments that form the tunnel wall. The lower picture shows the pneumatic wrench used to tighten the heavy bolts. At the left, a worker is gauging the movement of the shield to keep it straight



water and ooze while the thirty-one-foot rings are bolted in place to form the tunnel walls.

Not long after the new tunnel was dedicated, I descended to the second tube, going "into the air" to talk to sandhogs and learn, first-hand, the hazards of their work.

Before you step aboard the open elevator which takes you down to the air lock, within which the pressure is raised until it equals that inside the tunnel, a doctor examines your heart, lungs, and ears. Then you sign a green, printed form that releases the contractor from all liability in case of accident or death. Finally, after you have slipped into khaki overalls, pulled on galoshes, and donned a protecting synthetic-resin helmet, you crawl after your engineer-guide through the small door that leads into the air lock.

This steel chamber is about twenty feet long and eight feet in diameter. It suggests a huge locomotive boiler, studded with rivets and coated with red-lead paint. There are four of these locks in the end of the tunnel. Two are for materials, one for the workmen, and a fourth for emergency exit if the tunnel is flooded.

The steel door clangs shut behind you. The lock operator moves a small lever and a hissing, deafening roar fills the chamber. Your eardrums ache with the mounting pressure. You swallow, yawn, hold your nose, and blow to clear out the head passages and equalize pressure on the drums. A strict rule of the air locks is that the operator must close the valve as soon as one of the sandhogs raises his hand to indicate he is "blocked up" or unable to clear out his head passages. This sometimes happens when a workman has a cold. Halting the increase in pressure for a few moments prevents the rupture of an eardrum.

You watch the needle on the pressure gauge swing slowly past 5, 10, 15. At 16, the number of pounds above normal atmospheric pressure at which the sandhogs are working, the operator closes the valve and the door at the other end of the chamber opens. You step out into the twilight of the tube itself. Dim electric lights reveal a seemingly endless succession of rings, like the metal ribs of a huge monster, curving far above your head. They

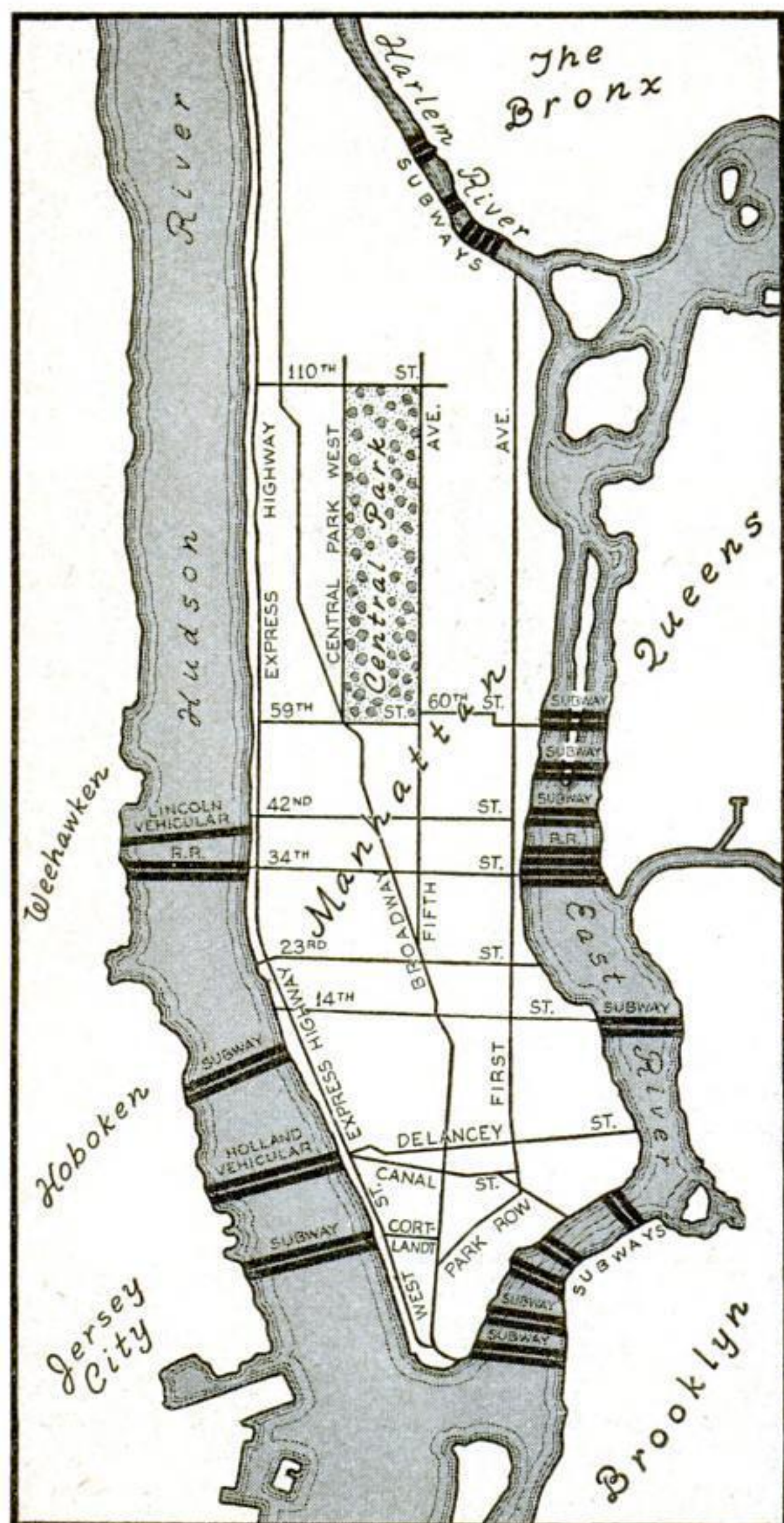
rise higher than a two-story building.

The air presses against your face with a heavy, earthy smell. As you pick your way down the great tube, you discover curious things about the effects of compressed air.

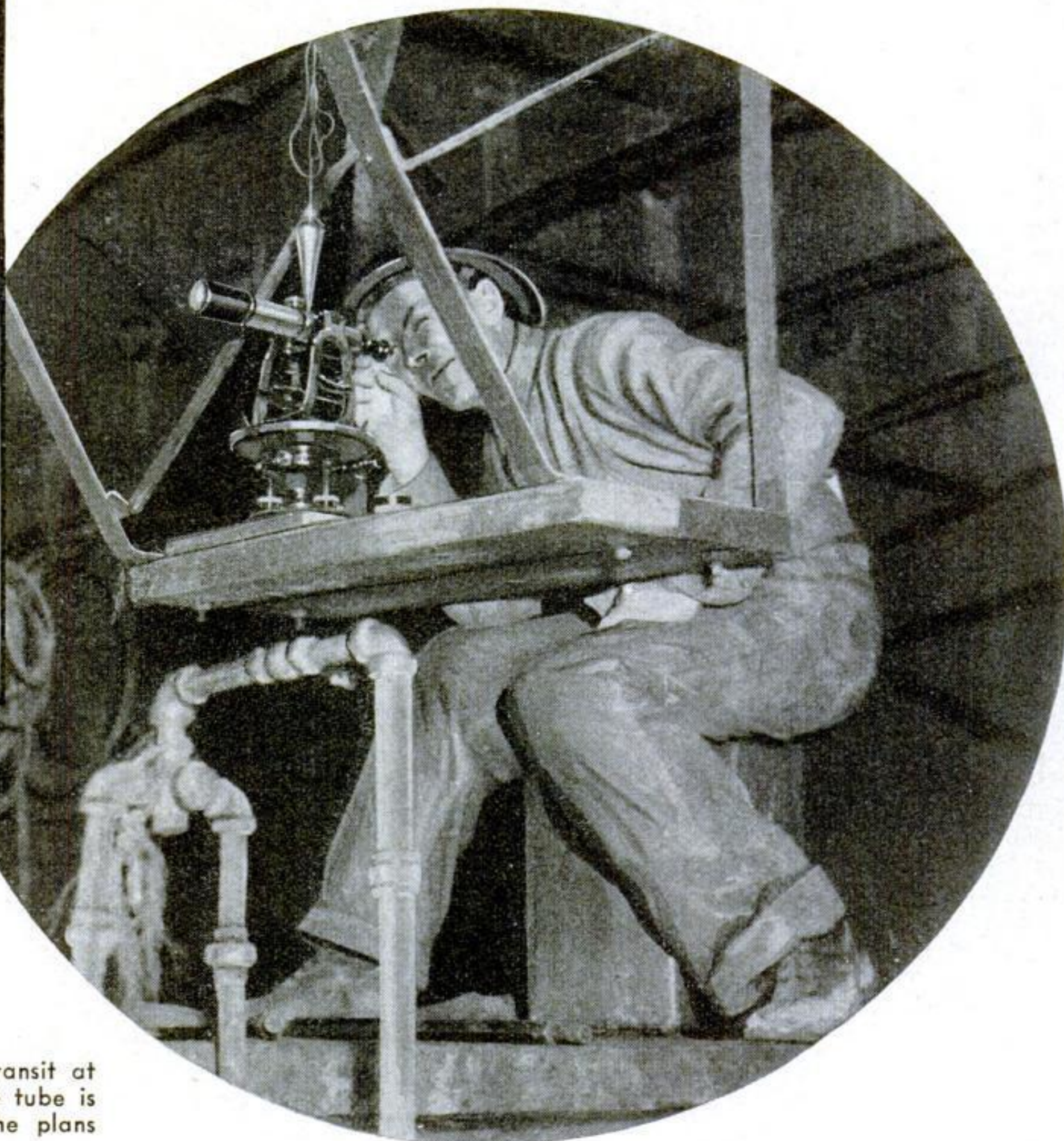
You notice that the voices of the men around you are nasal. Under high pressures, your guide tells you, all voices sound alike. You try to whistle. Only the high notes are audible. At fifty pounds, you can neither whistle nor whisper. A violin played in compressed air loses half its tone volume. You notice that you breathe less frequently than when under normal pressure. The explanation is the greater concentration of oxygen in the air.

An eighth of a mile under the river, you come to the immense cutting shield that forms the steel nose of the tube. It is here that nine tenths of the activity takes place. Sandhogs cluster around it like bees on a honeycomb. Each time the thirty superpower hydraulic jacks, pushing against the iron frame of the tunnel, drive the shield forward, a ribbon of bluish clay streams back through an opening in the shield. Much of the river-bed material is shoved aside as the "cookie cutter" advances, but part of it enters the tunnel like toothpaste squeezed from a giant tube.

Workmen with wires and shovels swarm around this clay ribbon. They slice it into smaller pieces which are tossed back and spread over the bottom of the tunnel to form ballast. Later, when the finished tube is lined with concrete, this clay is removed. Without ballast of some sort, the shell of the tunnel might rise, dirigible fashion, through the [\(Continued on page 121\)](#)



Manhattan Island, the heart of New York City, with the network of forty tunnels that connect it with New Jersey, Long Island, and the mainland of New York State. Thousands of cars, trains, and trucks flow into the city every day through the beds of the Hudson, East, and Harlem rivers by way of these steel tubes



The "tunnel navigator" sighting through his transit at a target 100 feet away, to make sure that the tube is following the exact line laid out for it on the plans

AMATEUR Dare-Devils

GIVE MOTOR-CYCLE RODEOS



Fourteen men on a motor cycle. This stunt by the Los Angeles club set a world's record for live weight on a stock machine

WEARING natty military uniforms and riding standard American-made motor cycles, a group of thirty-three amateur riders, all Los Angeles, Calif., business and professional men, recently won for the United States the International Motor-Cycle Trophy, emblem of world supremacy in acrobatic riding. Organized two years ago under the sponsorship of Victor McLaglen, motion-picture star, these dare-devil amateurs spend their spare time learning new tricks and giving thrilling exhibitions of stunt riding in western cities. Their coveted world title was captured from a team in Mexico City, which previously took it from the police team of London, England.

In addition to the international cup, the Victor McLaglen Motor Corps also holds the world's record for live weight put on any stock motor cycle. Fourteen men, with a total weight of 2,503 pounds, were pyramided upon one machine, which had not been strengthened in any way except that

its standard tires were inflated to 120 pounds pressure. Exhibitions include not only acrobatic riding but also complicated evolutions performed with military precision by the corps' formation drill team.



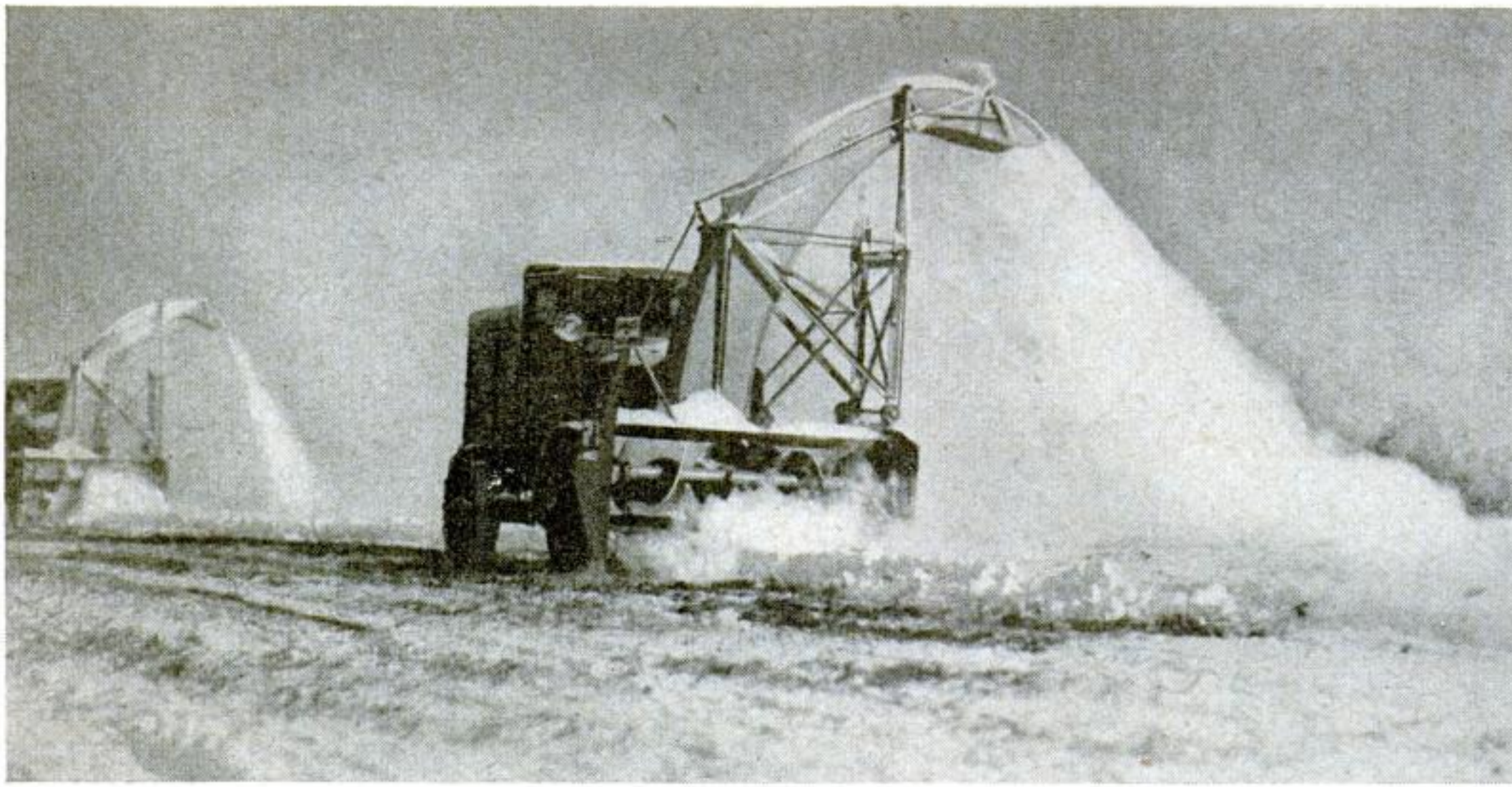
The "flying trapeze" as performed by the crack acrobatic team. The bar is supported by a steel pipe mounted on the rear carrying rack



It took eight months of practice to perfect this three-decked pyramid using six men and two motor cycles

The Victor McLaglen Motor Corps in parade formation, in its natty uniforms and with colors flying





Novel Machines Clear City Streets of Snow

RESEMBLING giant prehistoric monsters, new machines recently put into service in New York City make short work of clearing streets of wintry drifts. Whirling blades in a hopper at the front of a power-

ful truck bite into ice and packed snow, grinding it into fragments that are blown up a curved chute, to fall in neat banks at the side of the street for later removal by means of trucks.

Light for Musicians Is Worn on Cap

PINNED to the cap of a bandman's uniform, a specially designed flash light illuminates music for playing at evening sports events or parades. A battery contained in the unit furnishes current for about an hour of continuous use, after which it can be quickly replaced.



This light illuminates music at night



Violin Body Made with Match Sticks and Glue

MATCH sticks glued together with metal cement form the top and sides of a unique violin made by J. O. McCullough, of Tallassee, Ala. The tone and volume of the instrument are said to be about the same as those of an ordinary violin, and the novel material stands up well under the considerable strain created when the strings are tightened in tuning.

Eye Winks Form Code

A LANGUAGE of eye winks for paralysis victims has been worked out by Maurice Sciaky, of New York City, himself an invalid. Sufferers who cannot talk, write, or use the finger language of deaf-mutes spell out words by a code of winks denoting the various letters of the alphabet.

Portable "Secretary" Contains Typewriter

INTENDED for use by traveling authors, business men, and students, a fitted case now on the market contains a noiseless portable typewriter and all the accessories needed in writing. As seen in the photograph at the right, the front and sides of the leather case can be let down, and the lid contains pockets for stationery and files. The unit is fitted with fountain pen, pencils, erasers, scissors, magnifying rule, paste, a pocket for stamps, and a box for holding paper clips.



Fitted writing case open, showing typewriter and handy accessories

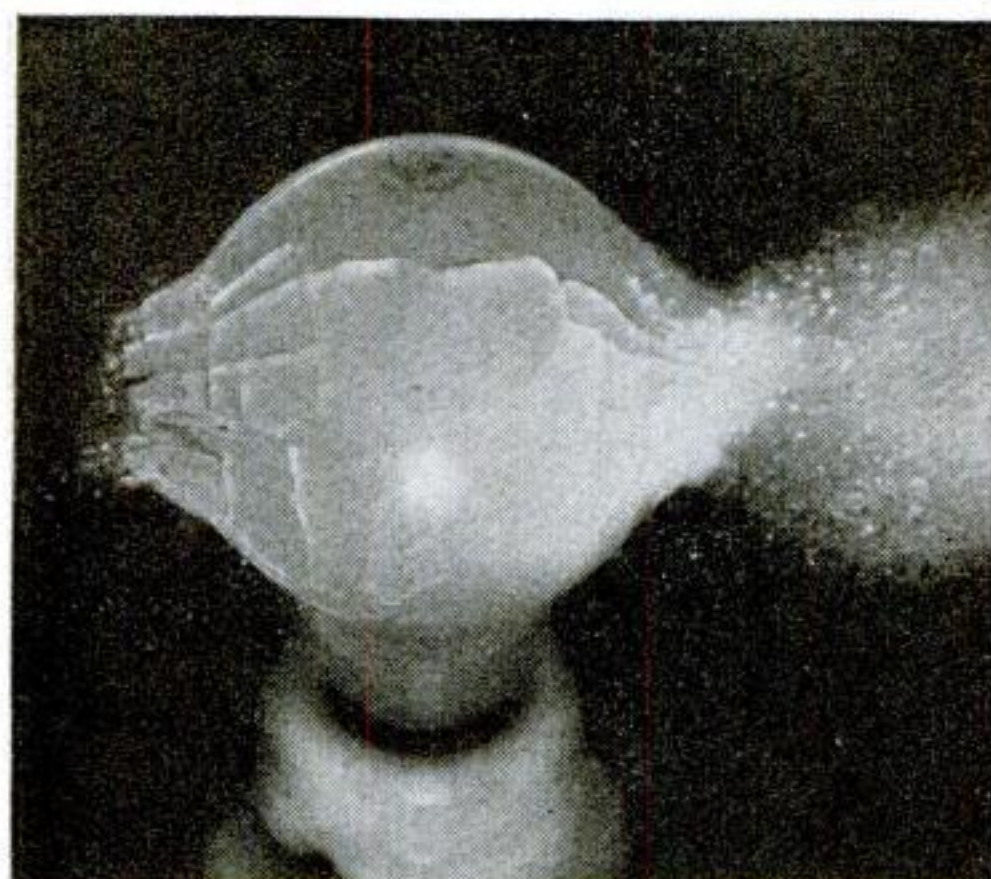
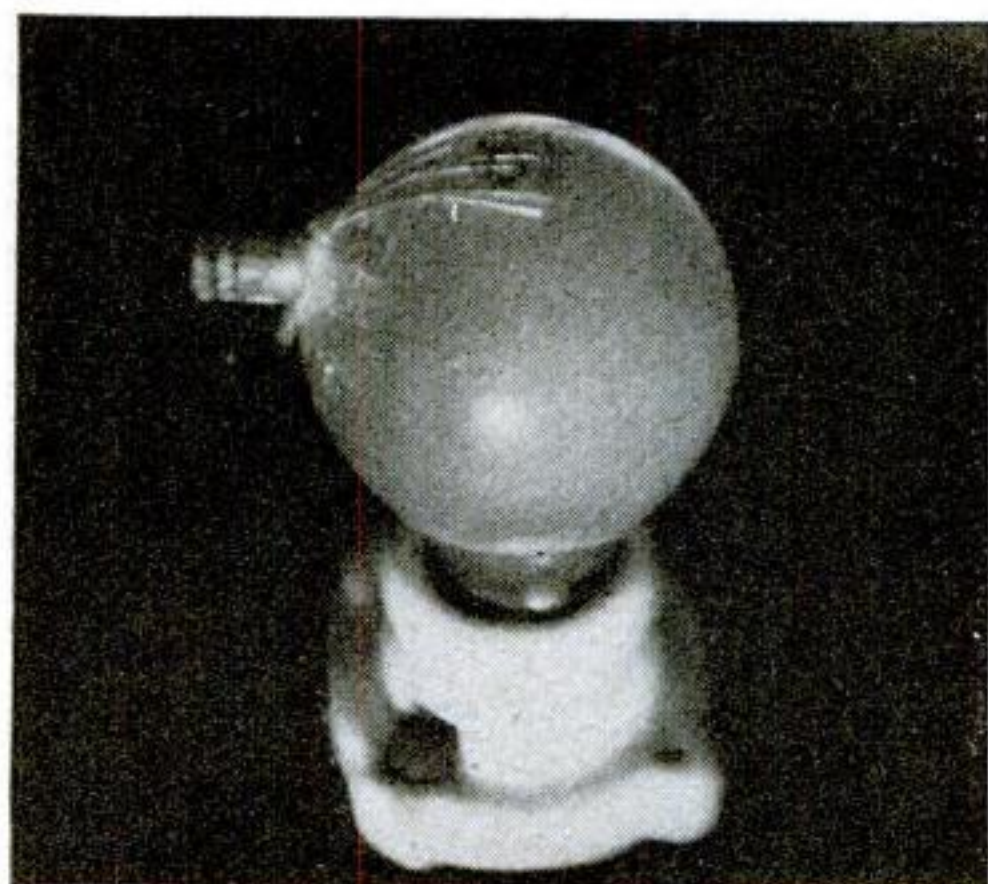


Players learning to be good automobile drivers with new game

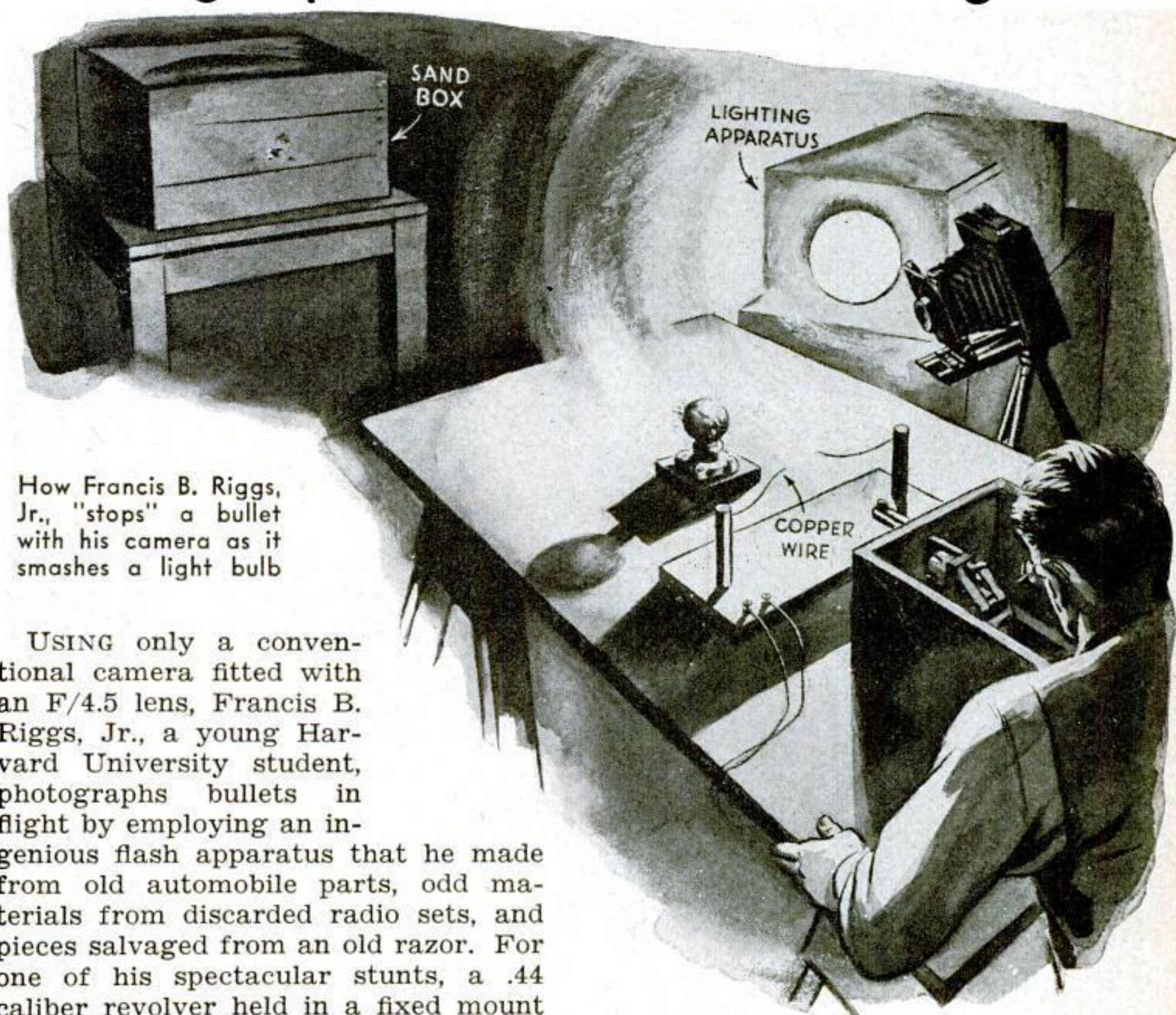
Traffic Game Teaches Rules of the Road

IN ADDITION to providing entertainment, a game recently introduced in Germany teaches players the latest laws governing motor traffic. On a board bearing a map of a maze of streets and boulevards, counters representing automobiles, motor cycles, and other vehicles are moved in accordance with throws of dice.

Student Takes Photographs of Bullets in Flight



In the upper photograph, a bullet is seen at the instant of its striking the glass. The lower picture shows a bullet leaving a bulb, with finely shattered glass caught in flight



How Francis B. Riggs, Jr., "stops" a bullet with his camera as it smashes a light bulb

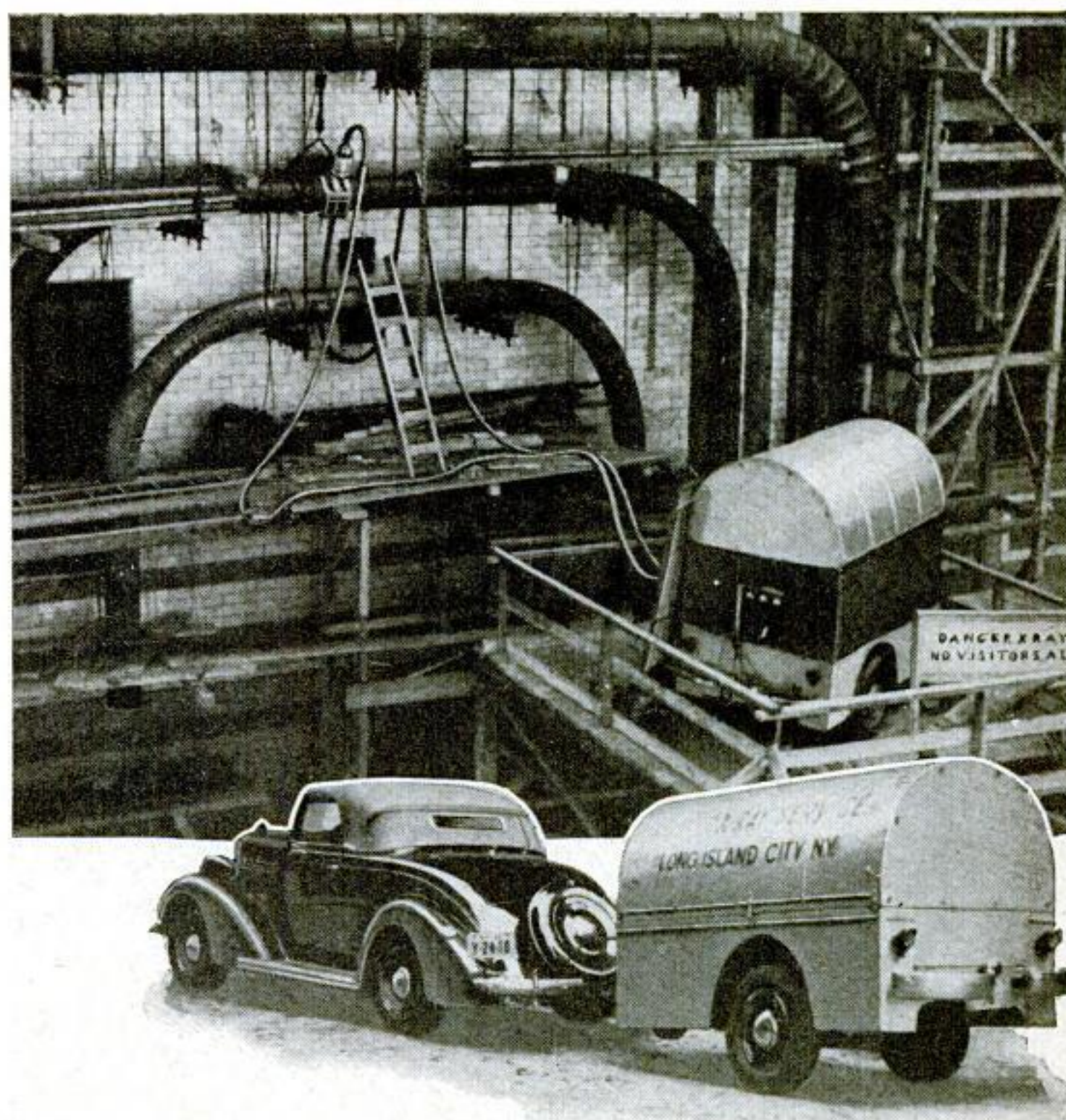
USING only a conventional camera fitted with an F/4.5 lens, Francis B. Riggs, Jr., a young Harvard University student, photographs bullets in flight by employing an ingenious flash apparatus that he made from old automobile parts, odd materials from discarded radio sets, and pieces salvaged from an old razor. For one of his spectacular stunts, a .44 caliber revolver held in a fixed mount is trained on an electric-light bulb set in the center of a table. Between the bulb and the gun muzzle, Riggs stretches a copper wire, which, when snapped by the bullet, sets off the

homemade apparatus to flash a brilliant light that lasts for about one millionth of a second, "stopping" the projectile as it enters the light bulb. The photographing is done in a darkened room.

Home-Movie Lights Follow Camera

FASTENED to the swivel top on a tripod, a novel photoflood lighting unit just introduced turns automatically with a movie camera as the latter is swung from one position to another. Fitted with adjustable arms for holding the reflector units, the accessory is light in weight and easy to attach. The metal reflectors fold flat for easy carrying.

Photoflood lights on adjustable arms mounted on a camera tripod for making home movies

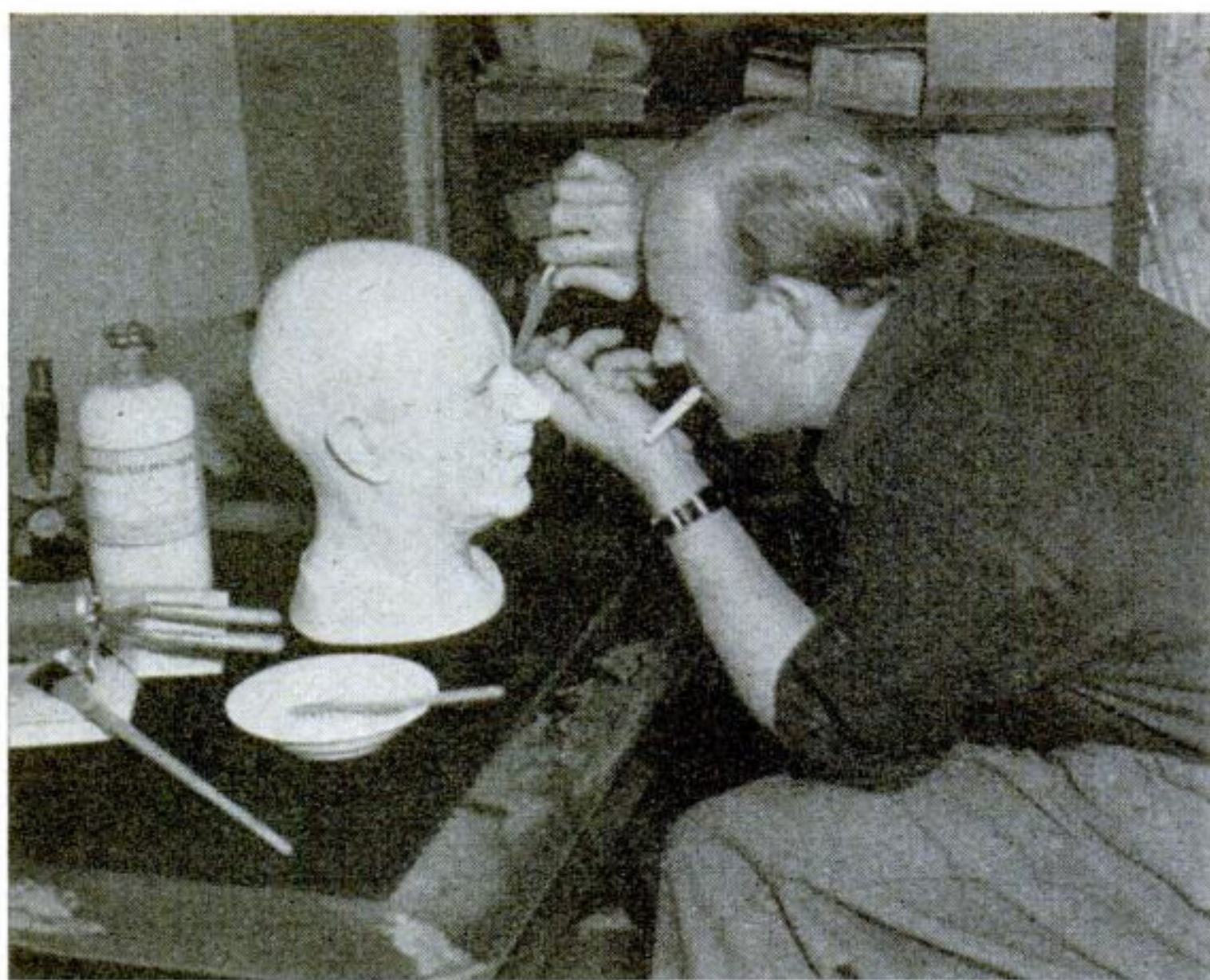


Trailer Houses X-Ray Laboratory

MOUNTED on a two-wheel trailer truck, a portable apparatus now in service is an X-ray laboratory on wheels. Used primarily for testing welds in pipes designed to carry live steam, the unit contains complete X-ray apparatus including a shockproof tube, cables, and electrical transformer. With the top jacked up and curtains hung at the side, the trailer can serve as a darkroom for developing photographs.



Lucien Littlefield, famous character actor in motion pictures, putting finishing touches on his make-up for the rôle of a villain in a recent film. The nose has been built up with molded artificial rubber



1 Using a new technique which he worked out for himself, Littlefield starts altering the contours of his face for a Chinese rôle by applying modeling clay around the eyes of a plaster model of his head

'Rubber' Make-Up Gives

A NEW era in the development of make-up for stage and screen is forecast by the introduction of a rubber plastic material that has been adopted for make-up use by Lucien Littlefield, screen star who specializes in character rôles. Employed in the manufacture of gasoline-pump hose, printing rollers, and protective coverings for electric cable, the rubber plastic, developed by Du Pont chemists, makes it unnecessary to resort to painful skin-stretching, padding, and other uncomfortable expedients of the type used by the late Lon Chaney when he made himself up for character parts. Photographs on these pages show in detail the various steps in fashioning and molding the rubber make-up, which, when applied to the face, is flexible enough to reproduce all the movements of the skin as the actor smiles, frowns,

or portrays other emotions. The plastic is not appreciably affected by the oil in grease paint and will not dry out, crack, or lose its shape under the heat and glare of the giant studio lamps. On a full-size plaster model of his head, Littlefield applies modeling clay, modeling the nose, cheek bones, eyes, and other features of the character he is to represent. From this he makes a plaster-of-Paris cast, lines it with a thin layer of absorbent cotton, and pours the liquid plastic into the parts where his normal features have been altered. When set, the rubber nose, cheeks, and other features are removed, applied to his face, and tinted to a flesh color. These are then smoothed out so that no dividing line shows where they join unchanged portions of the face. When false eyebrows, mustache, and other make-up accessories are added he is ready to face the camera.

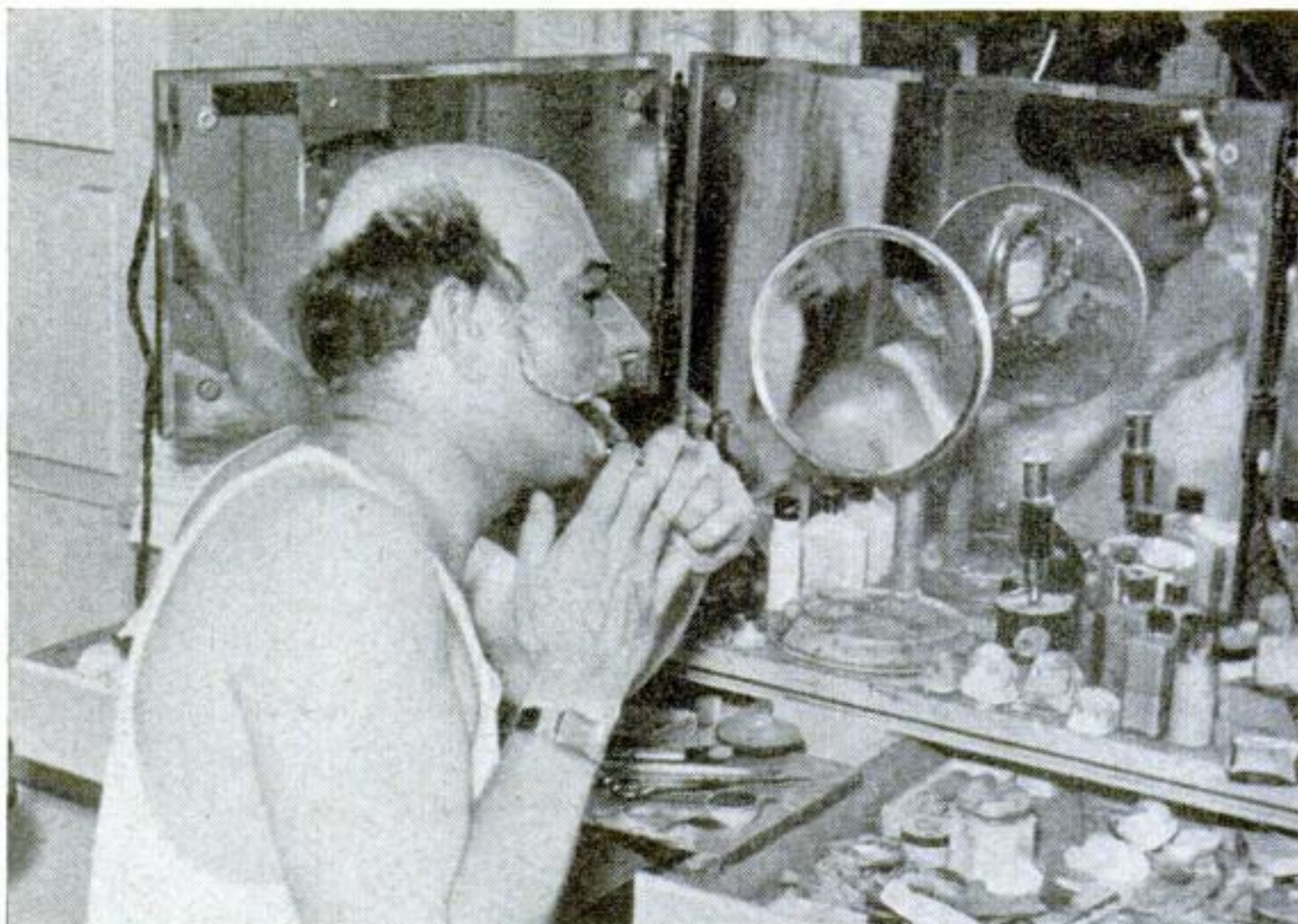
PHOTOGRAPHS COURTESY OF
PARAMOUNT PRODUCTIONS, INC.



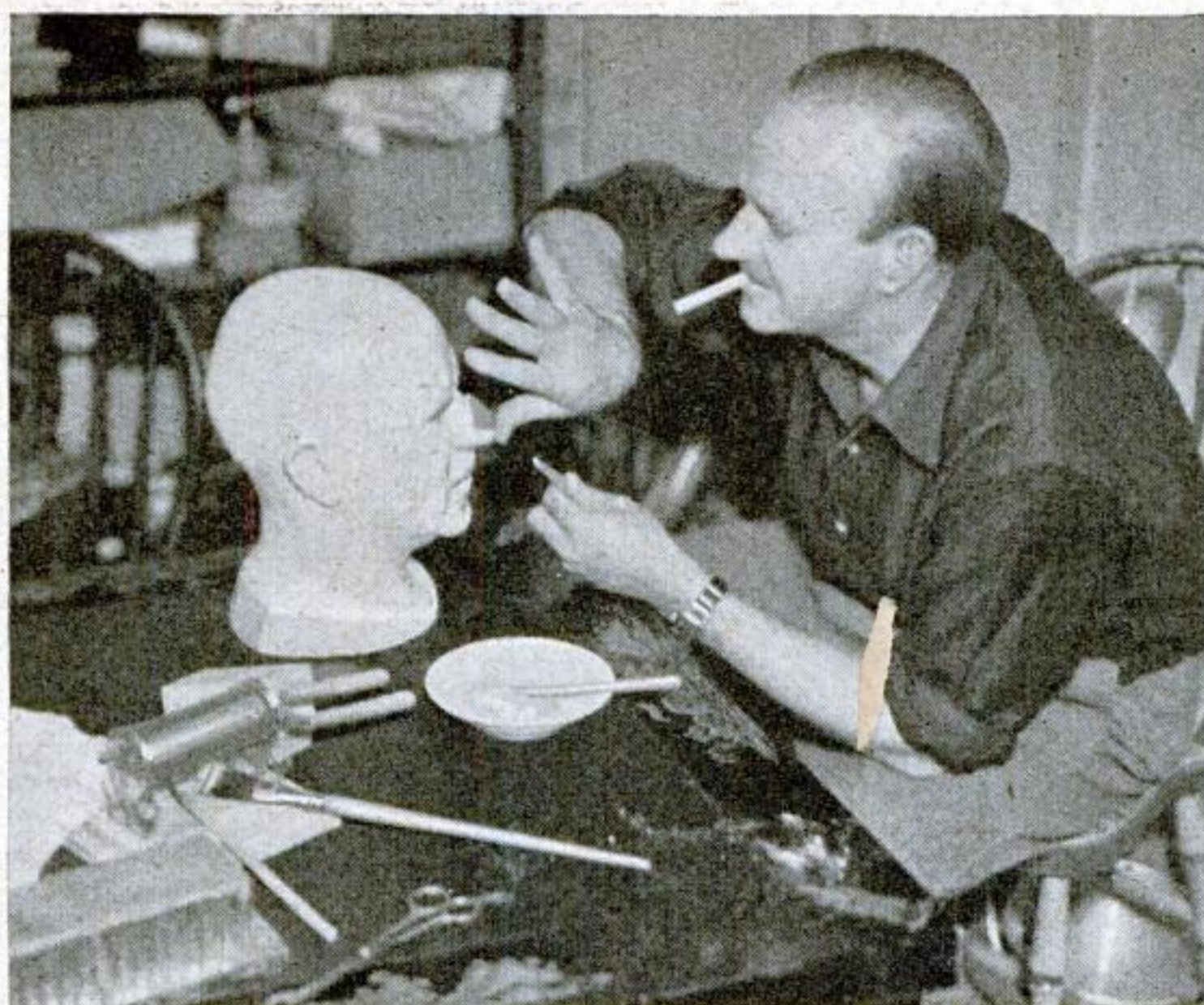
Playing a different type of character in another picture, he sports a new kind of nose



4 When the face is built up to the desired shape, plaster of Paris is put over it to form a cast. In this view, the actor is seen removing the plaster cast, which will be used in molding the rubber



7 Beginning the actual work of making up, the actor applies the molded cheek bones to his face. The material is flexible like rubber, but is not affected by oil, grease paint, or studio lights



2 In the same manner, clay is put on the nose of the model and is shaped by hand into the contours that the experienced actor considers appropriate for the character he will portray in the new movie



3 To reproduce the high cheek bones of an Oriental, this part of the face is raised with clay. Here Littlefield is seen using a sculptor's tool to give the eyes the necessary slanting appearance

Actor Many Faces

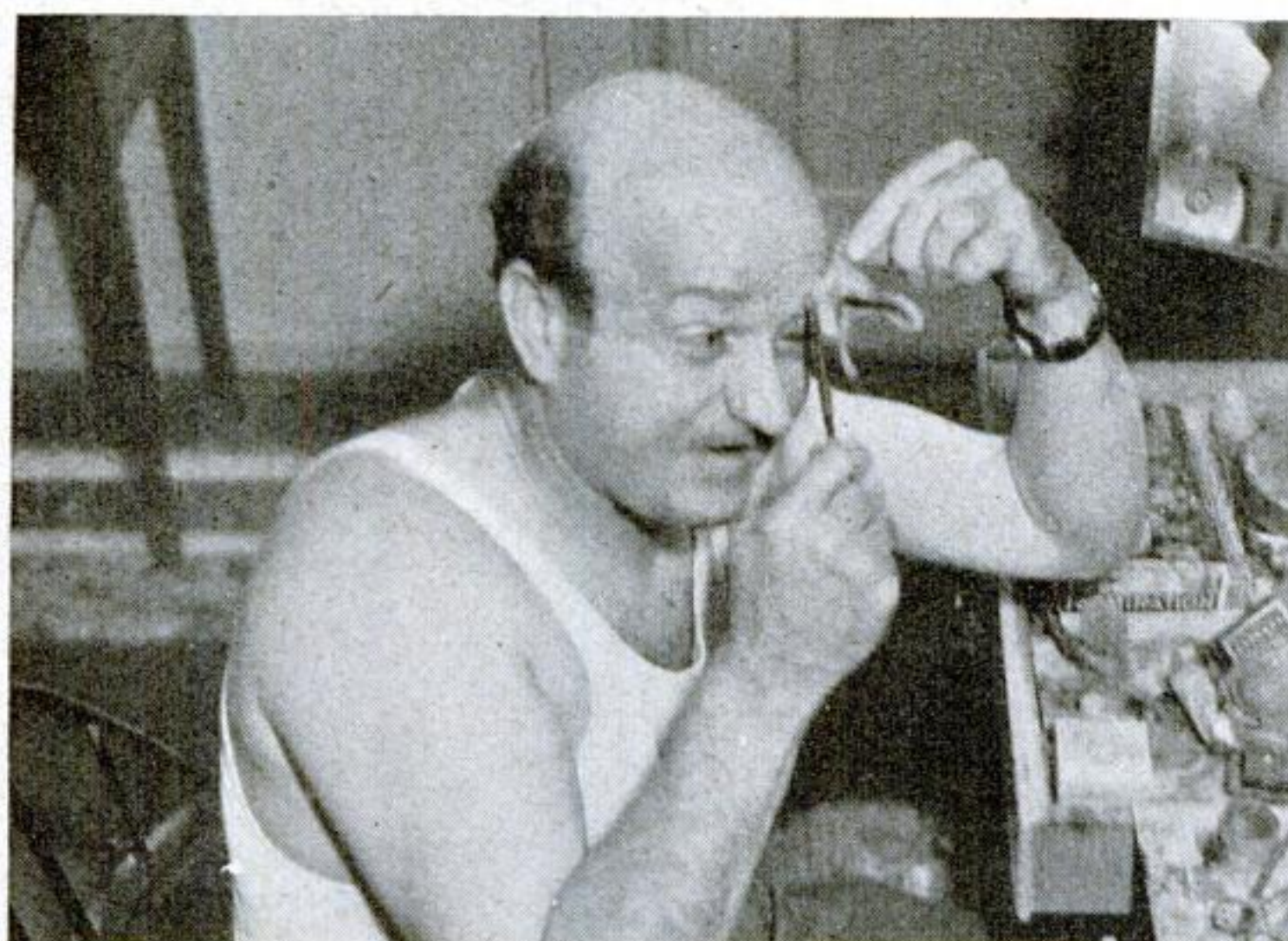
NEW FEATURES MOLDED
TO SUIT ANY CHARACTER



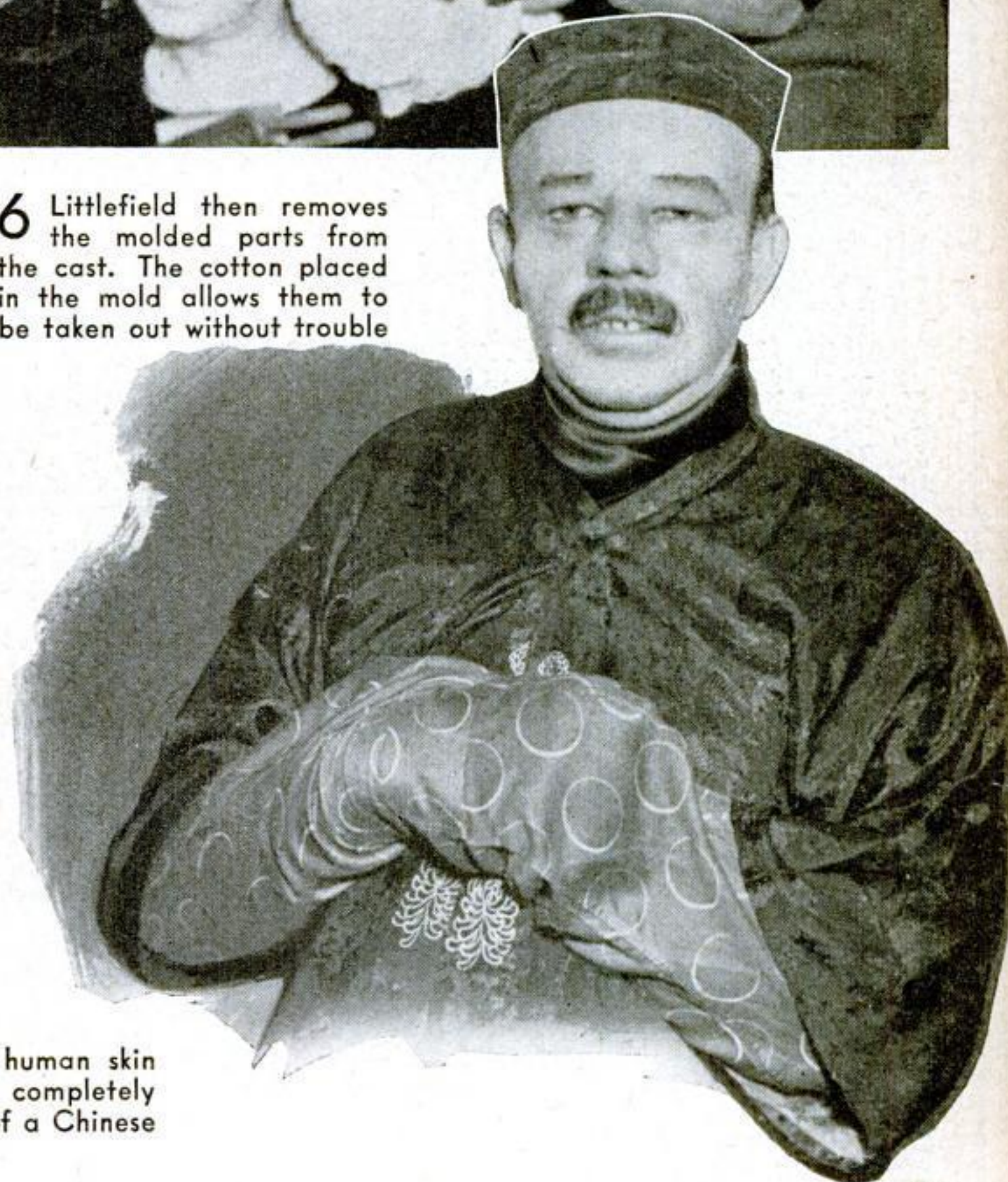
5 After a thin layer of absorbent cotton has been pressed into the mold, artificial latex is poured into the parts where the shape of the face has been changed. The liquid is left to harden in the sun



6 Littlefield then removes the molded parts from the cast. The cotton placed in the mold allows them to be taken out without trouble

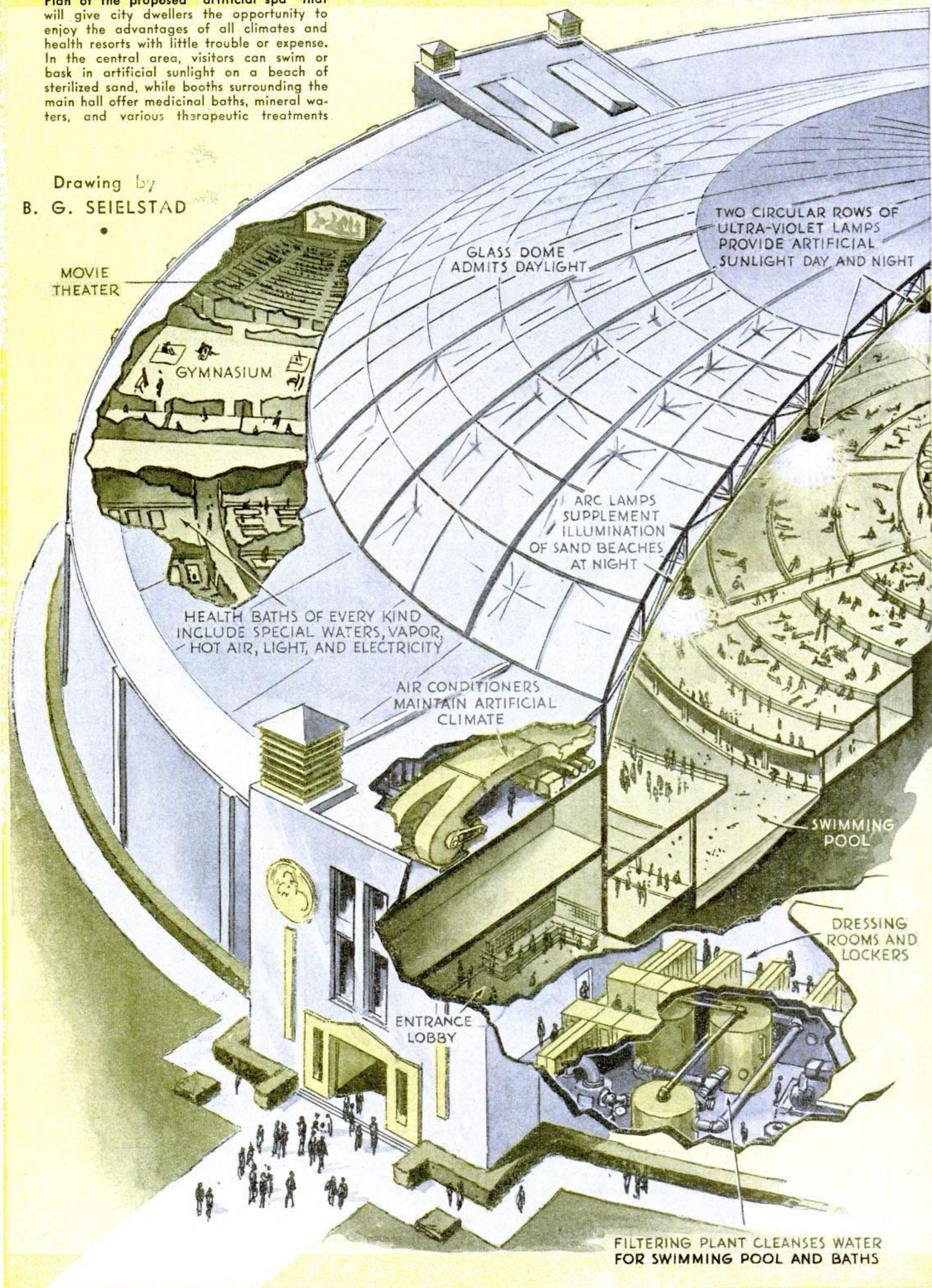


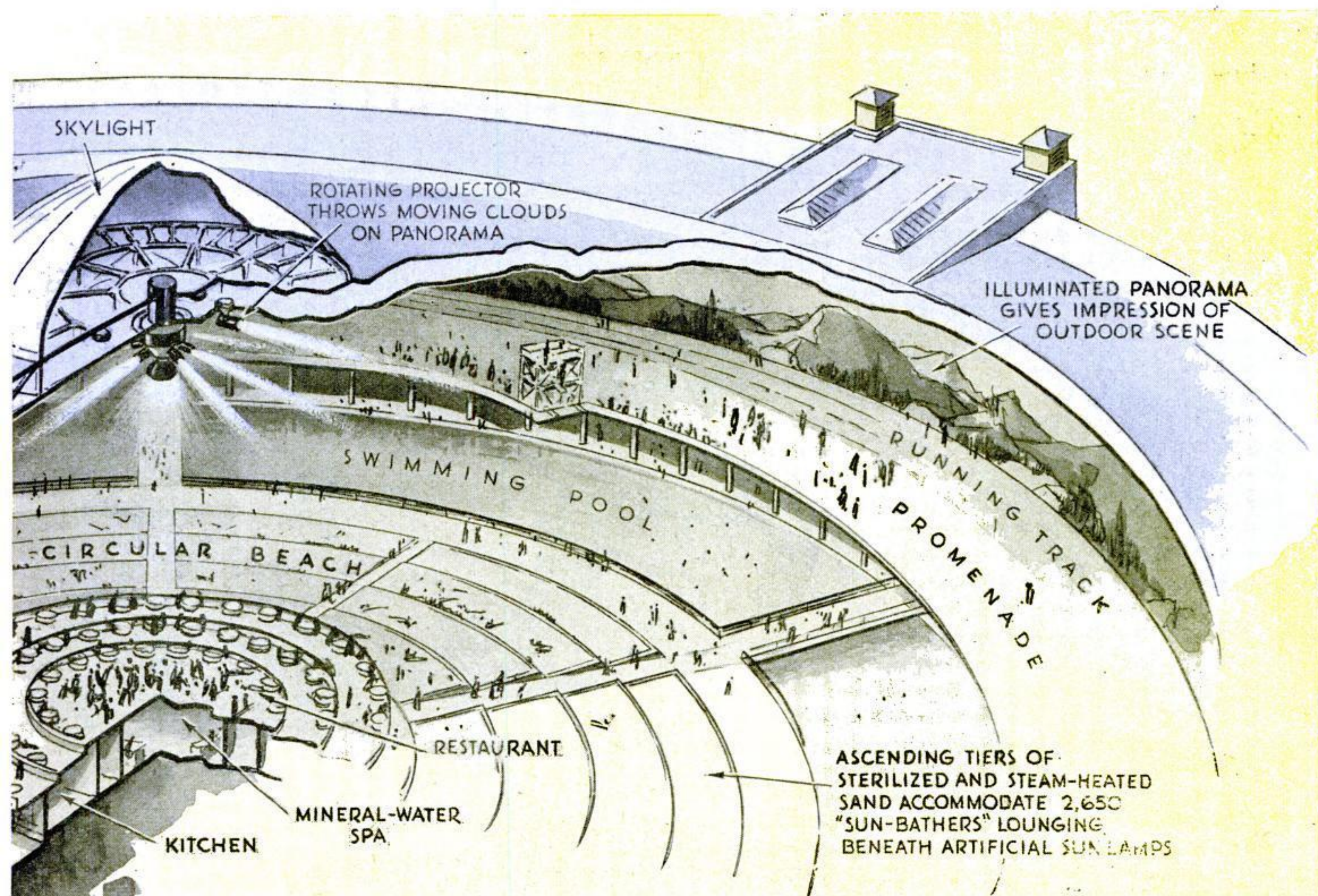
8 Now the eyebrows go on. The artificial features look exactly like human skin when they are given a flesh tint. At the right, Littlefield is seen completely made up for his part, ready to step before the camera in the character of a Chinese



Plan of the proposed "artificial spa" that will give city dwellers the opportunity to enjoy the advantages of all climates and health resorts with little trouble or expense. In the central area, visitors can swim or bask in artificial sunlight on a beach of sterilized sand, while booths surrounding the main hall offer medicinal baths, mineral waters, and various therapeutic treatments.

Drawing by
B. G. SEIELSTAD





Any Climate You Want

ALL THE WORLD'S HEALTH RESORTS PUT UNDER ONE ROOF

CURATIVE baths of the world's most famous spas, mineral waters from celebrated springs, and artificial climates to match seashore and mountains are brought together in a monster "artificial spa" designed by Dr. I. Goldmerstein of Paris, France, and Prof. Karl Stodieck of Berlin, Germany. Their plan would place all the benefits of expensive health resorts within reach of the inhabitants of large cities, they told a recent meeting of a scientific society in New York.

The project calls for a circular, glass-domed structure enclosing six and a half acres, to be erected at a cost of \$6,000,000 in the heart of the city, and to be open to the public for two periods daily. Paying a small admission fee and trading his street clothes for a bathing suit, a visitor finds himself in a vast amphitheater illuminated day and night by artificial sun lamps. A few steps across a sandy promenade bring him to the edge of a ring-shaped swimming pool nearly a quarter mile in circumference. After a swim, he may lounge on the sterilized, steam-heated sand

of a circular terraced island at the center of the pool, chatting with friends or enjoying the music of an orchestra while he basks under the ultra-violet lamps. A huge scenic panorama encircling the amphitheater, artfully lighted and painted with moving clouds by a revolving projector, completes his illusion of an outdoor setting. If the feeling of a wet bathing suit detracts from his pleasure, "hot box" compartments and ingenious presses dry him and his suit almost instantly.

Booths surrounding this main hall offer the visitor the additional benefits, at charges depending upon the treatment, of medicinal baths of every description—with mineral waters, hot air, vapor, therapeutic lamps, and X-ray treatments. Air-conditioning magic brings him the mellow climate of Florida or the dry air of Arizona and New Mexico, while he sips bottled Carlsbad water from Czechoslovakia, Vichy water from France, Saratoga Springs water from New York State, or sulphur waters from Virginia.

Additional attractions include five gymnasiums, a movie theater, more

than a mile of walks along which to stroll, and a running track for those more athletically inclined, as well as sporting matches and other special diversions.

A maze of machinery behind the scenes caters to the needs of the thousands who flock to the health and recreation center. No sooner does the visitor doff his street attire than his linen is whisked away by an automatic aerial conveyor—to be returned to him freshly washed and ironed, from a subterranean laundry, when he is ready to depart. Sand travels back and forth, by way of an electric car and hoist, between the beaches and a sterilizer capable of disinfecting several freight-car loads a day with superheated steam at 300 degrees.

To overcome the disadvantage of hanging the quartz sun lamps at a great height, special chromium-plated reflectors multiply the effective illumination fivefold. A "Schwedler dome," an advanced architectural design of parabolic shape and great strength, solves the problem of providing a roof 600 feet in diameter and free from central supporting pillars.

Leg Splint for Animals IS NAILED TO THE BONE



This dog has had a broken bone set with the new splint. Note the extension bar

BONE fractures that bring long suffering to dogs and other small animals, and have made it necessary to destroy horses and cattle, now can be mended successfully. Using an ingenious splint of his own design, Dr. Otto Stader, of Philadelphia, Pa., has saved hundreds of valuable animals, maimed by broken bones, from suffering and death. The accompanying photographs show how the humane operation is performed on the fractured leg of a dog.

The animal first is anesthetized. Fur is shaved from the leg, and two stainless-steel pins, pointing somewhat toward each other, are driven through each section of the broken bone. An adjustable bar grips the pairs of pins and permits them to be drawn to the proper position to allow the bone to set and heal. The animal can use the limb as soon as it comes out of the anesthetic. Later, the pins are removed.



With the patient anesthetized, doctors place the stainless-steel pins in position to be driven into the bone. Previous examination with an X-ray fluoroscope has shown where they should enter

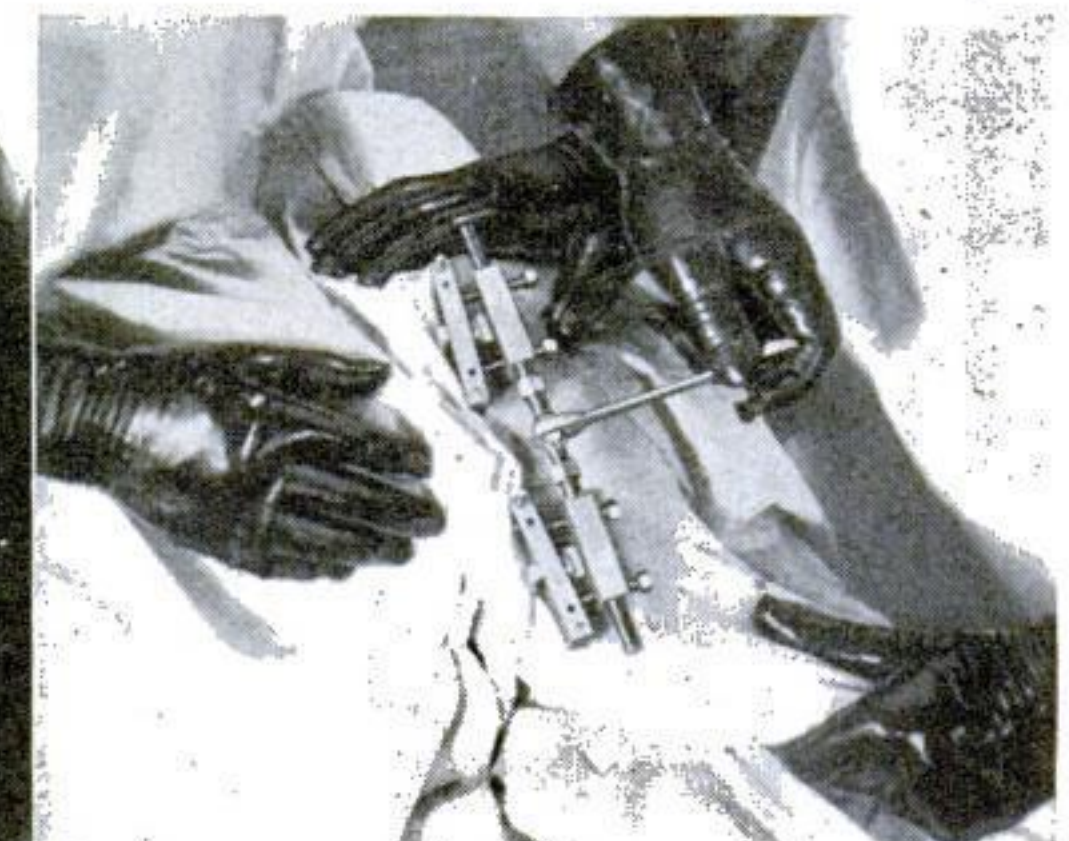
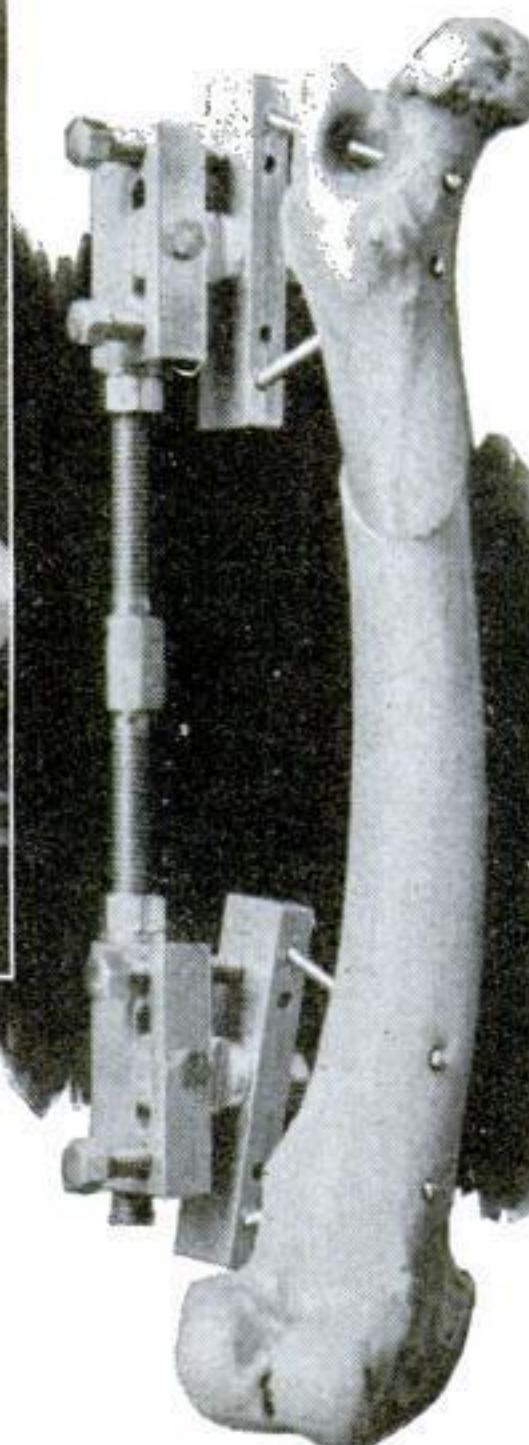


Blocks holding the two pairs of pins are joined with an adjustable bar that enables the surgeon to set the bone. Two of the pins hold the bone above the break, and the other two below it

At right, the surgeon is drawing the pieces of bone together with the guidance of the fluoroscope. Below is an X-ray picture of the completed job to show the positions of pins and extension bar



At the right, the splint is applied to a bone to show how it works. It eliminates the need for a plaster cast, which interferes with circulation of the blood. The animal can put its weight on the broken leg



With the pins driven down, a wrench is fitted to the extension bar, which operates like a turnbuckle to draw the blocks together. Pins are driven slantwise for greater holding power

Armored Tank Hits High Speed

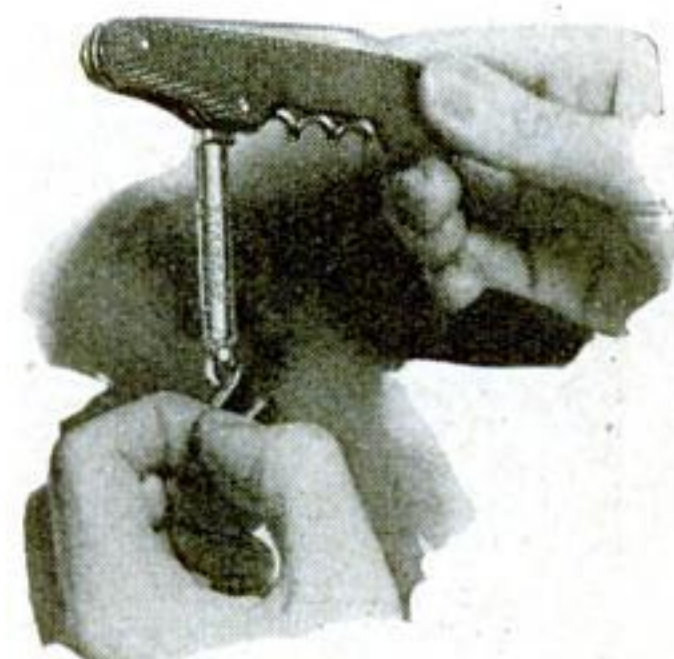


This is the fastest tank running on endless treads

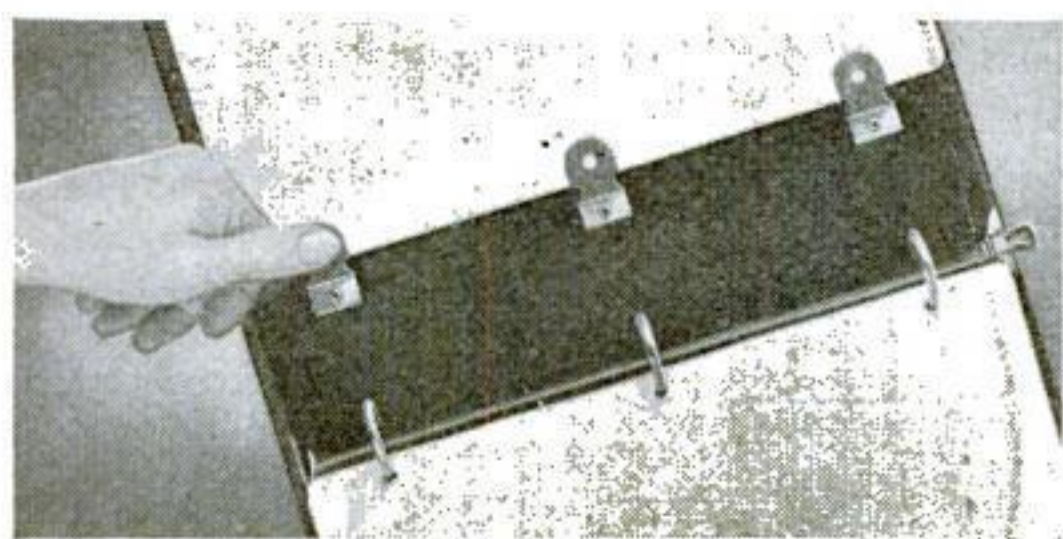
SPEEDING across open fields, negotiating ditches, shallow streams, and swamps, an armored tank just completed for a British firm reached a top speed of more than fifty miles an hour in test runs. Said to be the fastest endless-tread tank ever constructed, the vehicle is powered by a 435-horsepower airplane engine mounted in the rear. Only four feet high, the tank weighs approximately six tons and has eight shock-absorbing coil springs.

Fish Knife Has Scales

DESIGNED for anglers, a novel knife now on the market has a scale for weighing fish up to twelve pounds. In addition to the scale, the knife has a large stainless-steel blade, a pair of scissors, a corkscrew, tweezers, and an instrument for removing hooks from the fish. The weighing scale is being demonstrated at the right.



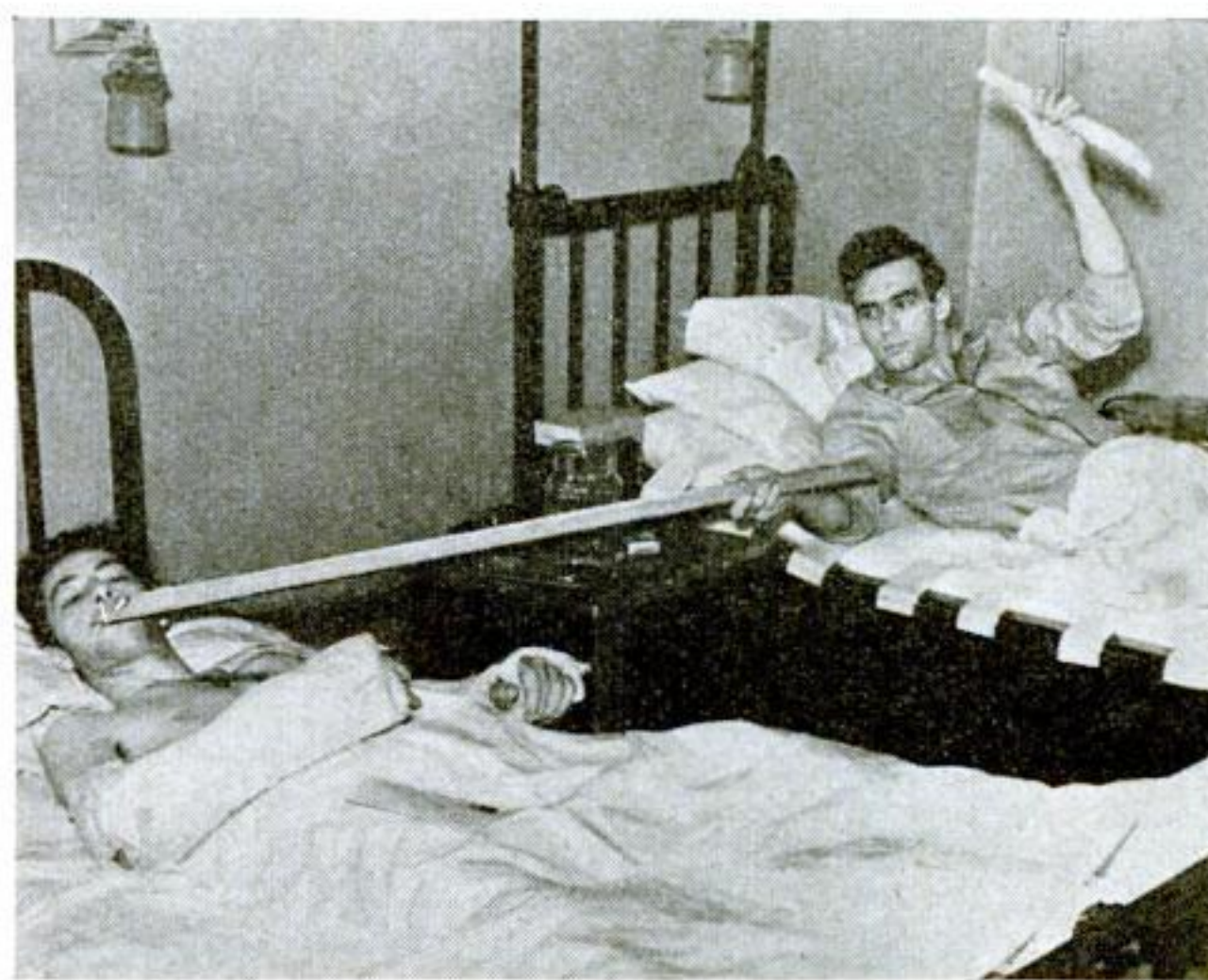
Fish-knife scale in use. It weighs up to twelve pounds



New Loose-Leaf Book Has Built-in Paper Punch

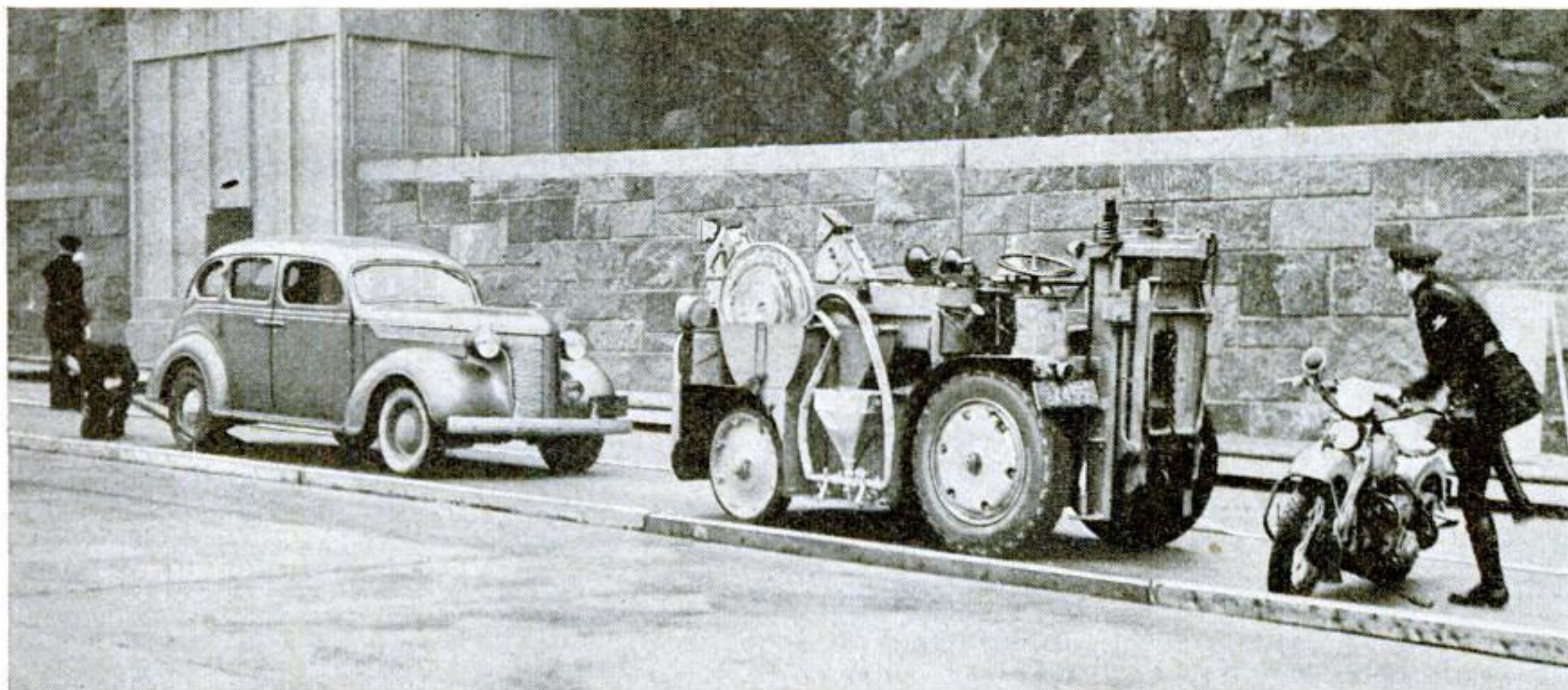
CONVENIENTLY located within the covers of a loose-leaf book, a punch now available makes it easy to insert additional sheets with holes properly spaced. When the sheets are placed on a line with the paper already in the book, a press of the thumb punches the holes as seen in the picture above. The punch may also be used independently of the ring book.

BECAUSE a patient with two broken arms was unable to hold a cigarette, authorities in a St. Louis, Mo., hospital devised the odd six-foot holder pictured at the right. A roommate lights a cigarette, places it in a hole in the end of the stick, and holds it to his friend's lips. To raise his body for the purpose, he uses a support suspended above his bed, as shown. A nail in the end of the holder is used to feed the patient candy.



Hospital patient helping his roommate to enjoy a smoke

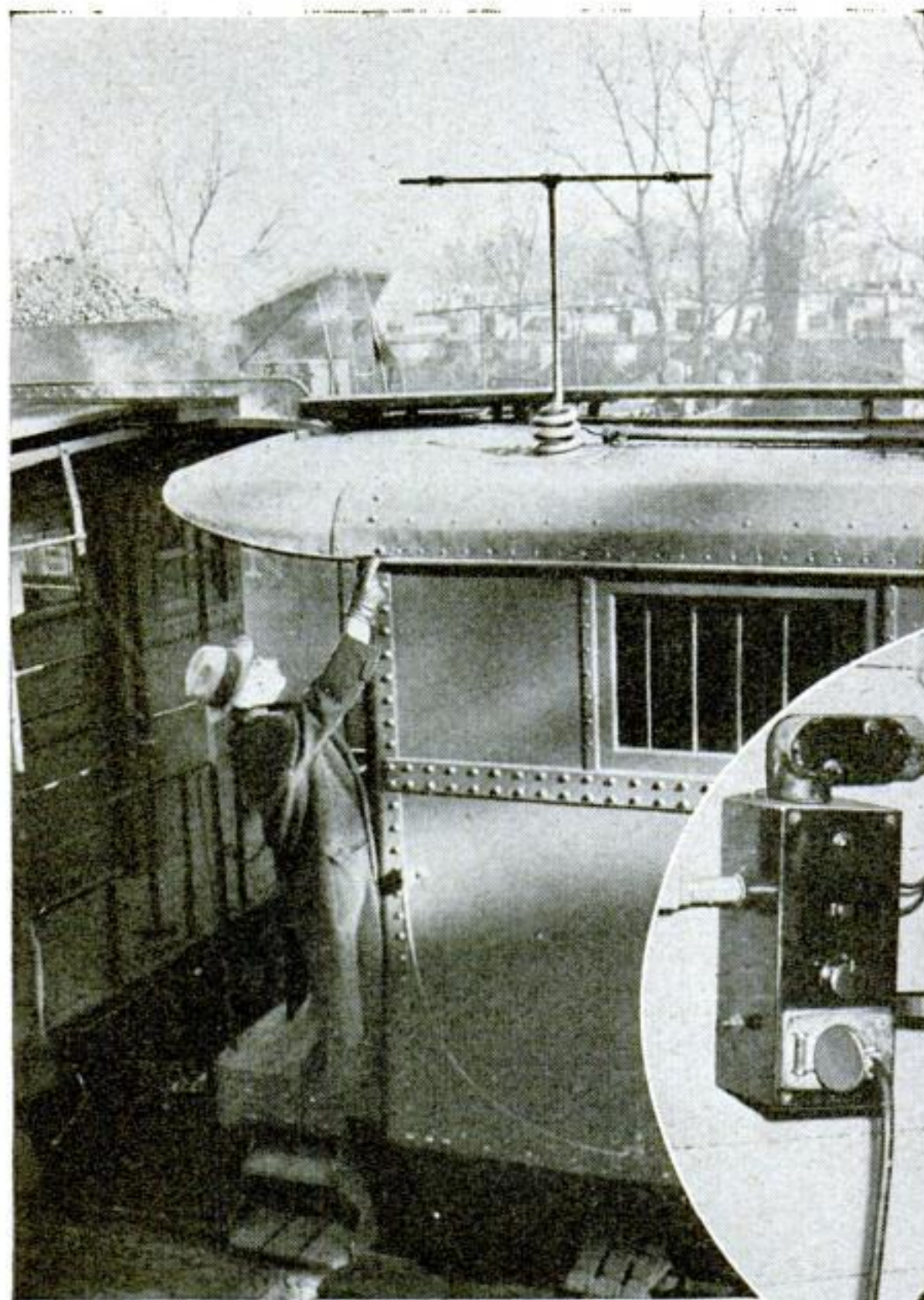
Odd Police Emergency Truck Aids Motorists in Tunnel



Police demonstrating how they change tires for motorists in the new Lincoln Tunnel under the Hudson River

A POLICE truck of novel design has just been placed in service in the new Lincoln vehicular tunnel under the Hudson River between New York City and New Jersey (see page 52). The odd vehicle, shown in the photograph at the left, is fitted with fire-fighting apparatus, tow cables, tire-changing tools, and other emergency equipment. Police will change all flat tires that occur within the tunnel, as the heavy two-way traffic makes it dangerous for motorists to do the work.

Two-Way Radios Speed Switching of Long Freights



Antenna installation for the new radio system that speeds the switching of cars

The fireman in the cab, right, is listening over a short-wave radio to the voice of his conductor many cars from him

Second short-wave system is placed in the caboose as below, to be used by the train's conductor



TO EXPEDITE efficient handling of long freight trains, an eastern railroad is experimenting with short-wave radio as a means of communication between the locomotive and the caboose. Two-way sets installed in the engine cab and in the rear car enable the engineer, brakeman, and conductor to eliminate the use of hand and lantern signals in picking up and shunting cars heading in or out of sidings, or performing other maneuvers required in handling long freight trains.

Youngster Gets "Wings" at Age of Four



The official private license is issued to the air-minded youngster

VALID until December 31, 2000, a novel airplane license recently issued by Australian air authorities entitles four-year-old Eric Morris to operate his homemade "flying flea," shown in the photograph below. The diminutive craft, modeled after a French plane, is fitted with a gasoline engine of one and a half horsepower that allows the young pilot to taxi it along the ground as fast as twelve miles an hour.



Four-year-old Eric Morris making twelve miles an hour along the ground in his plane



Humidor, left, fills a pipe in one operation. Below, how it is used



Tobacco Humidor Stokes Pipes Automatically

TWISTING a knob on top of a novel humidor just placed on the market fills a pipe with the right amount of tobacco. The pipe bowl is held under a spout, as shown in the illustration above, to catch the loose tobacco as it pours from the container. Besides furnishing just enough tobacco to fill the pipe, the dispenser is said to tamp the tobacco so as to permit the right amount of draft to flow through the bowl. The humidor also serves as an ash tray, and has racks for holding pipes, cigarettes, matches, and other accessories used by smokers.

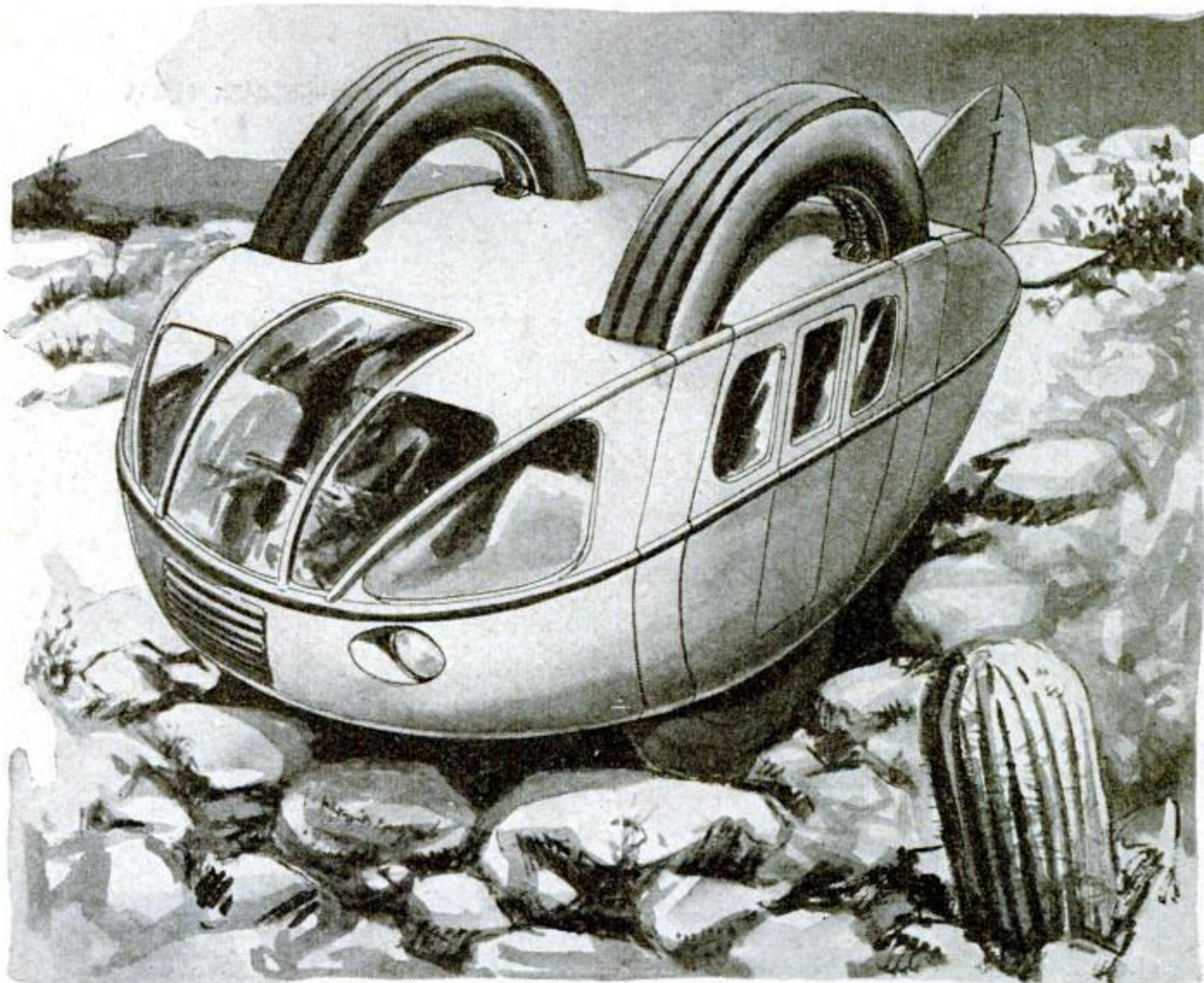


This device ignites a powder fuse and gives warning to the worker using it

Electric Fuse Lighter Makes Blasting Safer

A PORTABLE electric fuse lighter recently introduced is expected to contribute to the safety of blasting and dynamiting operations. In use, a fuse end is placed in the tool and two sharp electrodes are pressed into the fuse. When a switch is thrown, current from dry cells creates an electric spark that ignites the powder train instantly. Said to ignite fuses under both wet and dry conditions, the lighter gives a distinct report to indicate that the fuse is lit.

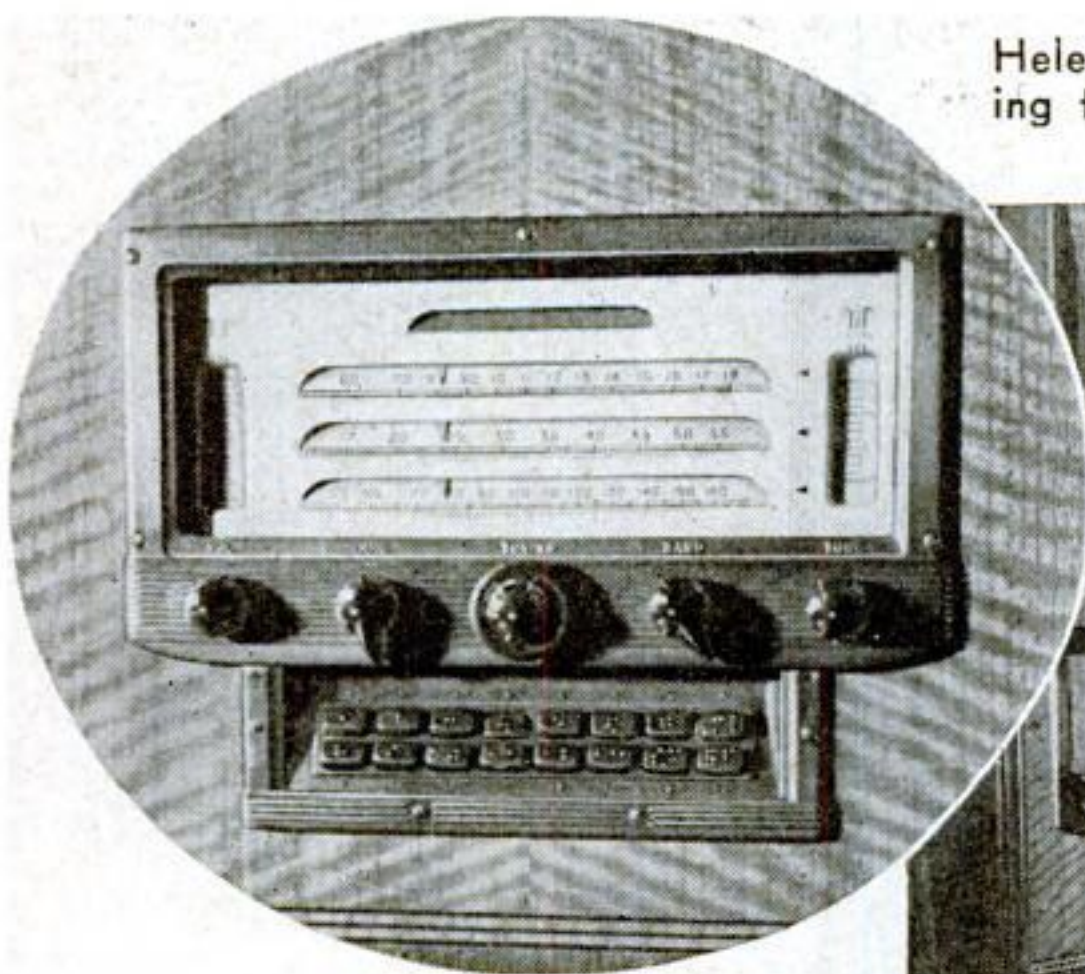
Two-Wheeled Car Runs on Giant Hoops



SPEEDING across open fields or along highways, negotiating ditches, streams, and swamps, a novel vehicle designed by Glenn Bryant of Cleveland Heights, Ohio, runs on two giant rubber-tired wheels as indicated in the drawing above. Suspended on small guide wheels from the mammoth rims, the streamline

body of the car has its center of gravity below the wheel axes to insure stability. At low speeds, steering can be accomplished by varying the speed of the individual wheels, while an airplane-type rudder supplements this method at high speeds. A gasoline engine drives the wheels by means of a pinion mechanism.

Special Radio for the Blind Is Tuned by Touch



Helen Keller, famous blind genius, explaining the new Braille radio dial seen at left

TUNING keys marked with Braille characters adapt a radio of standard make for use by the blind. Instead of tuning in a set by a method of trial and error, a blind person fingers the Braille lettering on a series of keys until he locates the one representing a desired station. Pushing this key automatically tunes the set to the station selected, by the method employed on a number of "touch-tuning" radios now on the market.



A demonstration of the use of the claw bar in pulling spikes



New Claw Bar Pulls Rail Spikes Easily

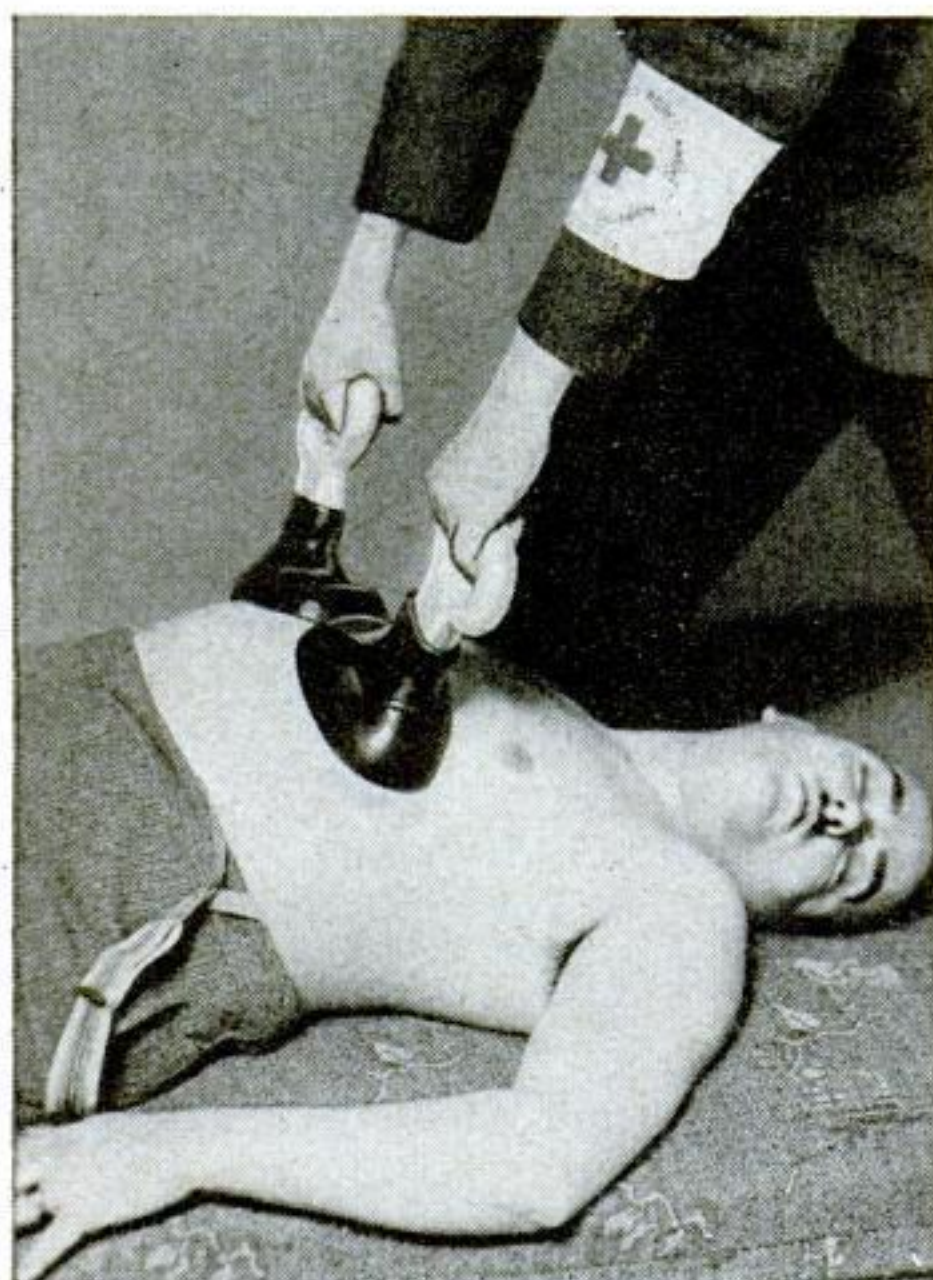
FOR removing old rails from railroad tracks, a long-handled claw bar just invented is said to pull the spikes with a minimum of effort. Also adapted to removing drift bolts, pile pins, and bridge bolts, the tool yanks them out without bending them, even though they are headless or broken, according to the inventor.



Gasoline "Burns" Snow from Athletic Field

GASOLINE, sprayed over the turf and ignited, was used recently to melt the snow and thaw out the frozen sod on an athletic field in Chicago, Ill. For badly frozen spots, an asphalt heater of the

type used in road construction was also employed. Following the thawing procedure, layers of straw were spread over the ground and covered with heavy tarpaulins until the field was to be used.



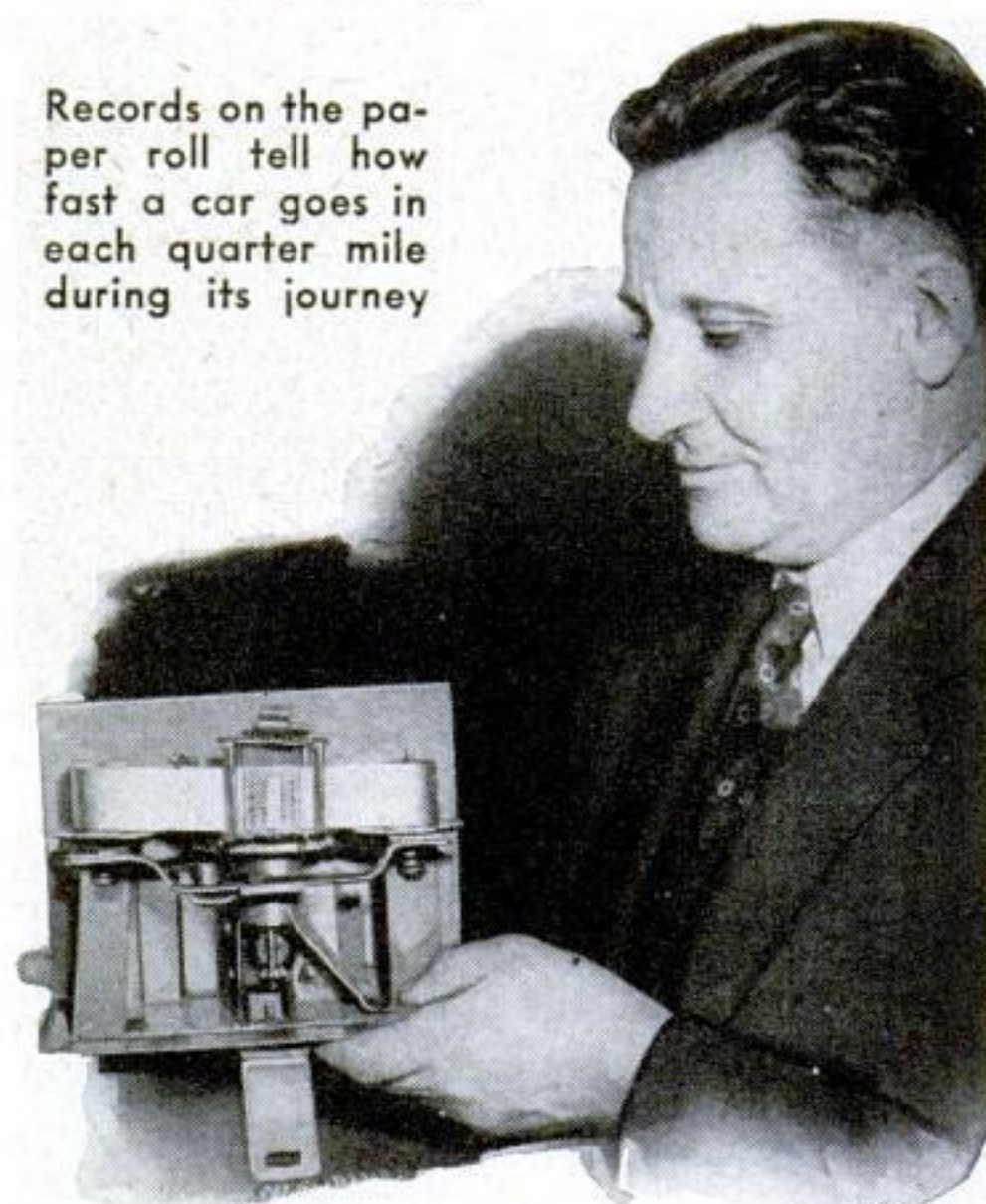
Suction Cups Revive Accident Victims

ARTIFICIAL respiration to revive persons suffering from paralysis of the diaphragm as a result of submersion in water, electric shock, and other causes, is administered by a novel suction-cup device recently invented in Germany. Fitted with special handles, two rubber cups shaped like halved eggs are applied to the chest of a patient lying on his back, as shown in the photograph reproduced above. Alternate lifting and releasing of the handles expands and contracts the diaphragm to simulate normal breathing.

Meter Keeps Record of a Car's Speed

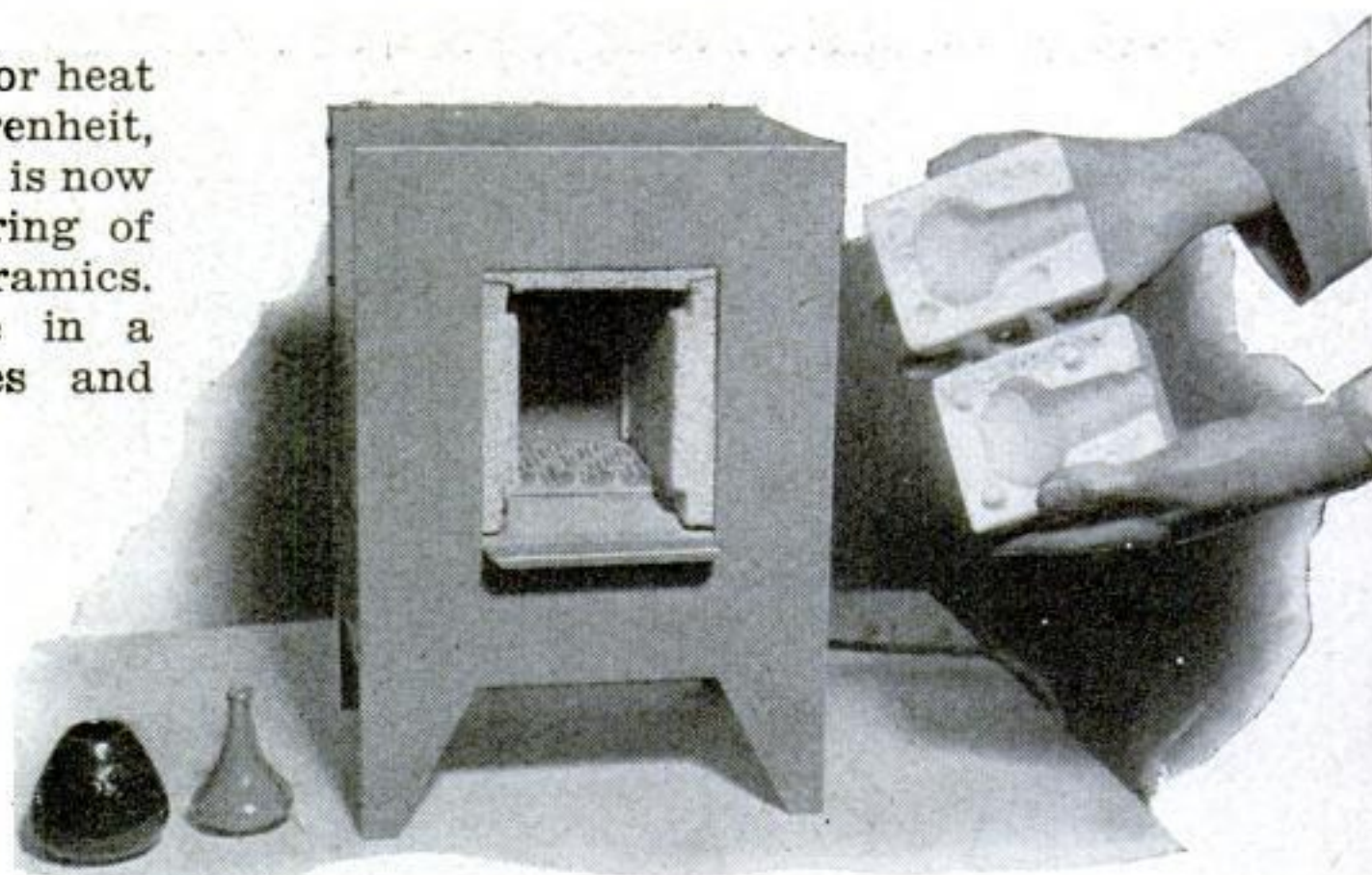
AUTOMATICALLY recording the speed a car has been traveling each quarter mile, a new instrument would settle arguments between speed cops and motorists, according to its inventor, Matt Niemi, of San Francisco, Calif. Quarter-mile car speeds are permanently registered by means of perforated markings on a moving roll of paper within the device.

Records on the paper roll tell how fast a car goes in each quarter mile during its journey



New Electric Kiln Aids Amateur Potters

CAPABLE of an interior heat of 2,000 degrees Fahrenheit, a compact electric kiln is now available for home firing of pottery and other ceramics. Molds are obtainable in a wide variety of sizes and shapes to fit into the small firing oven, which can be plugged into any electric outlet. With the electric kiln, it is also easy to bake a coating of colored enamel on the exterior surface of the finished products.



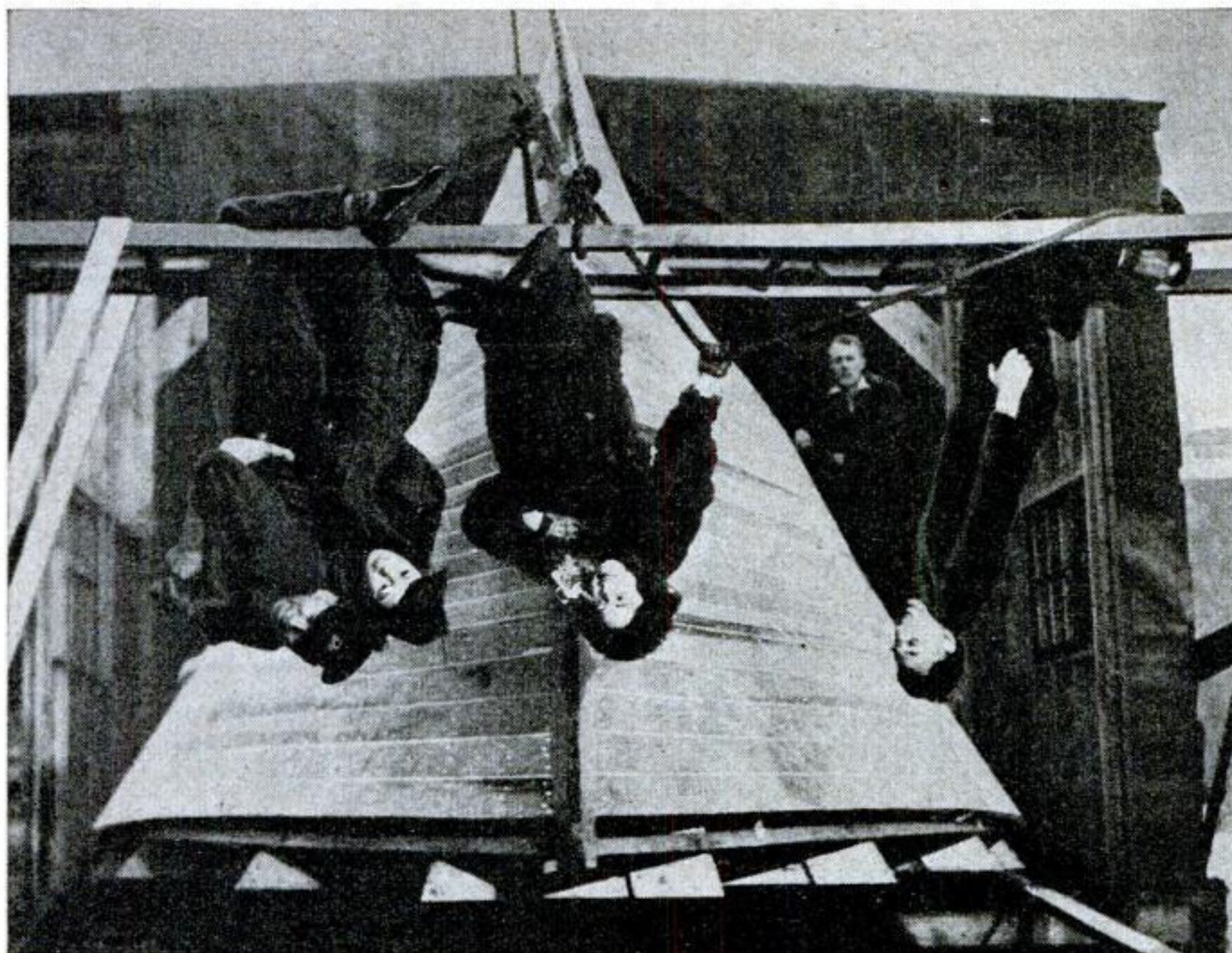
Heavily insulated, this kiln for making pottery uses house current



Workmen applying the new composition material to an English street

Street Is Paved with Rubber

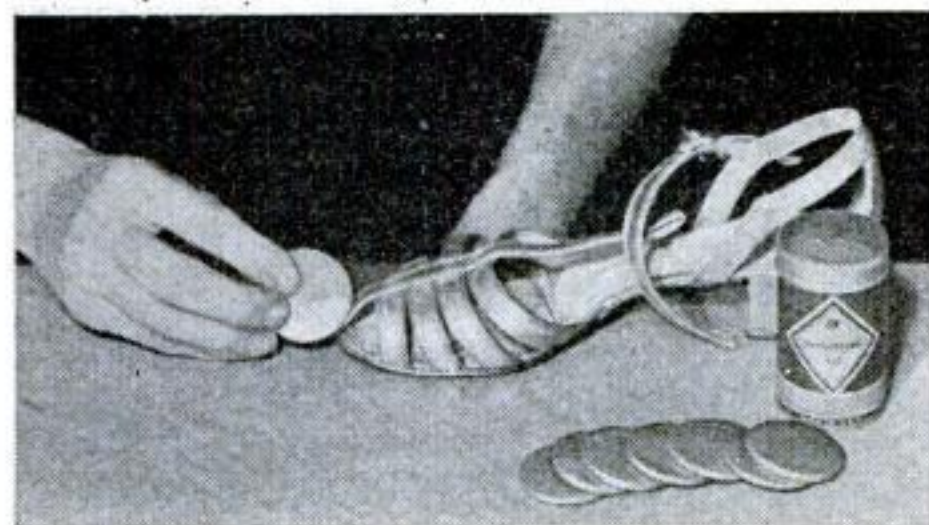
ROADS made of rubber are now possible with the development of a new composition material that can be laid like ordinary asphalt, as shown at the left. Tried out recently in England, the rubber substance, when set, is said to be skid-resisting, to reduce traffic noise, and to last as long as other road surfacings.



Launched upside down, this craft was christened by sponsors dangling head downward

Upside-down Boat Gets Acrobatic Christening

LAUNCHED upside down, a cabin cruiser recently built in Seattle, Wash., was christened by its sponsors while they hung head downward from a ladder scaffold. To simplify construction, the boat was built keel upward. After launching, the craft was righted, bailed out, and towed to a dock for the erection of its superstructure and fittings. The unusual photograph at the left was snapped just before the cruiser slid down the ways.

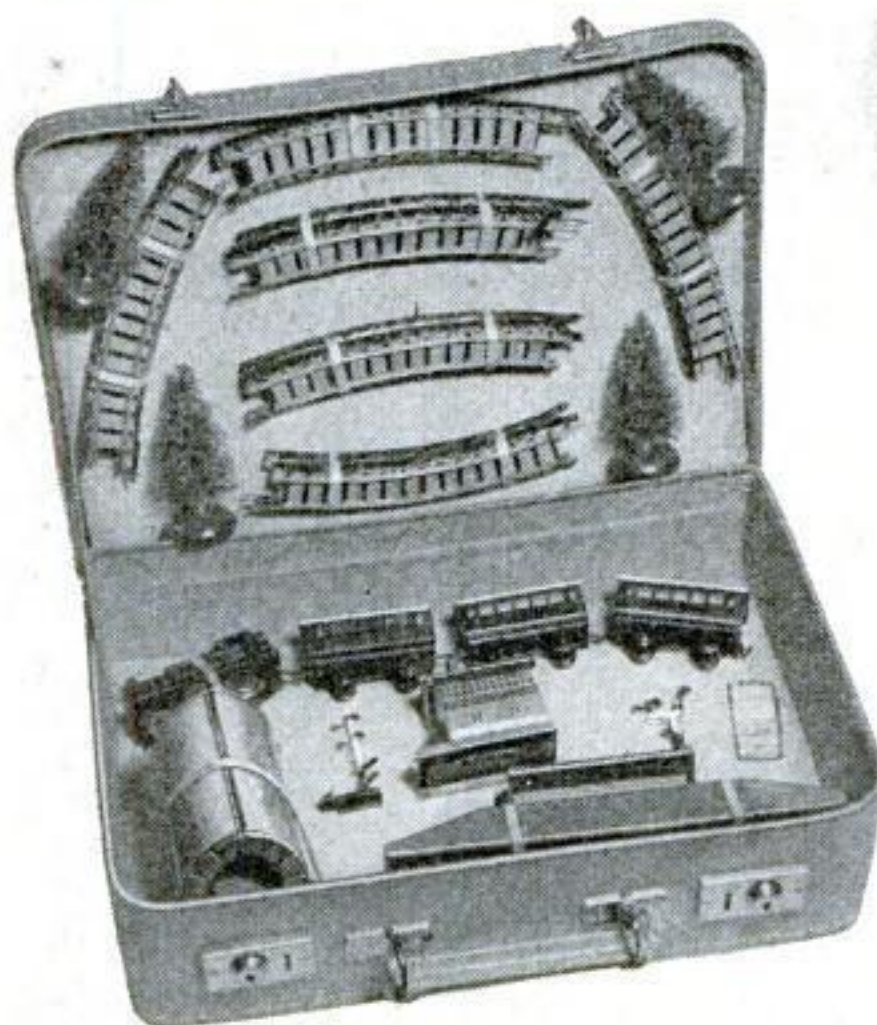


Crayonlike Disks Resilver Slippers

TOUCHING UP worn spots on women's silvered evening slippers is made easy by the new crayonlike disks shown at the left. When rubbed on worn spots, the disks deposit a thin layer of silver-colored pigment.

Mechanical-Train Set Fits Inside Suitcase

FITTING compactly into a small pigskin carrying case, the diminutive model railroad illustrated in the photograph at the right can be carried easily. The outfit consists of a spring-operated reversible locomotive, three passenger coaches, tunnel, trees, track, signals, and other equipment. Elastic strips in the top of the case hold the sections of track and the model trees, while other units are transported in the body of the bag. The locomotive is equipped with a reversing switch, and is about three inches long. The cars are of proportionate size, and the case is about thirteen by fifteen inches.



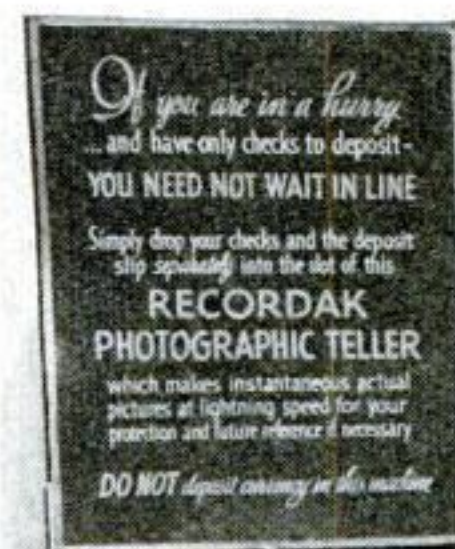
Tank Tows Army Platoon on Skis

SLIDING over the snow on skis, a platoon of soldiers was towed by a tank in recent winter maneuvers of the Russian army. With their rifles slung on straps over their shoulders, the infantrymen grasped ropes trailing from the rear of the tank, as shown in the photograph. The maneuver is expected to speed up troop movements.



For transporting ski squadrons speedily, the Russian army uses tanks to tow them, as in the photograph above

Camera Records Deposits



There's no waiting when depositors use the automatic teller



CUSTOMERS of banks equipped with a novel photographic teller do not have to wait in line to deposit checks. After making out a deposit slip, the customer feeds it into a slot in the electrically operated machine, and then inserts each check he wishes to deposit. Ingeniously photographed at the time of deposit, the items are entered by a regular teller at the close of business. Bank notes and coin deposits are not handled by the machine.

POPULAR SCIENCE

Question Bee

How well do you know the language and the facts of science and mechanics? Here is an entertaining way to test yourself. Try to select the single correct answer for each of the num-

bered questions below. Write down the letter corresponding to your answer in each case, and then compare your results with the list on page 129. Add up your points for your total score



1 A good thing to season meat with, at the dinner table, would be (a) potassium hydroxide (b) copper sulphate (c) sodium chloride (d) bichloride of mercury.

2 Poliomyelitis is the medical name for (a) hardening of the arteries (b) influenza (c) measles (d) infantile paralysis.

3 Carnivorous animals (a) live in caves (b) eat meat (c) have four legs (d) can climb trees.

4 Keen-edged tools like pocket knives, chisels, and plane blades are sharpened on (a) a touchstone (b) a Rosetta stone (c) an oilstone (d) a keystone.

5 An escapement is (a) a jail delivery (b) the place in a dam where excess water overflows (c) part of the driving mechanism of a clock.

6 In a historic demonstration staged by Otto von Guericke of Magdeburg, Germany, before Emperor Ferdinand III, two teams of strong horses were unable to pull apart (a) the first iron chain ever made (b) a Gordian knot (c) a pair of close-fitting copper hemispheres from which the air had been exhausted (d) an automobile tire and its demountable rim.

7 Ruminants are (a) inhabitants of Rumania (b) remedies for rheumatism (c) animals like the cow.

8 You should never (a) saw wood across the grain (b) touch an electric-light socket while standing in a bathtub filled with water (c) light three cigarettes with one match (d) put oil in the crankcase of a motor car.

9 Litmus paper is (a) sensitized paper for making photographic prints (b) a modern substitute for sandpaper (c) a parchment-like paper for cooking vegetables (d) treated paper used in testing for acids and alkalis.

10 Red corpuscles in your blood (a) fight germs (b) carry oxygen from the lungs to all parts of the body (c) clot the blood in a wound.

11 Two pieces of machinery adjusted to run at exactly the same speed are said to have been (a) syndicated (b) syncopated (c) synchronized.

12 If your car won't run, the trouble may be in the (a) spark arrester (b) gasometer (c) ohmmeter (d) transmitter (e) carburetor (f) "B" battery.

13 A Leyden jar is (a) a container for vacuum-packed food (b) a prized variety of pottery (c) a receptacle for liquid air (d) a device for storing electricity.

14 What makes your feet try to use the floorboard as a brake, when someone else is driving, is (a) a conditioned reflex (b) deductive reasoning (c) an inferiority complex (d) an inhibition.

15 Plywood is (a) a very flexible wood that can be bent double without breaking (b) wood built up of several thicknesses glued together (c) an extremely light wood that is often used for building model airplanes.

16 If ice cubes freeze together after you have taken them from the tray, you can blame it on (a) regelation (b) convection (c) sublimation.

17 A French curve is (a) a shape discovered to be acoustically perfect for violins (b) a drafting tool (c) a banked turn in a road or railway (d) a form of graph sometimes used for business statistics.

18 Rapidly moving pieces of machinery appear to stand still when they are viewed with a (a) stethoscope (b) stroboscope (c) horoscope (d) bronchoscope.

19 The radiator of an automobile (a) keeps the occupants warm in winter (b) makes the car easy to start in cold weather (c) helps to keep the motor from overheating.

20 Wave traps are (a) machines to harness the power of sea waves (b) tuned radio circuits (c) accessories for a trap drummer.

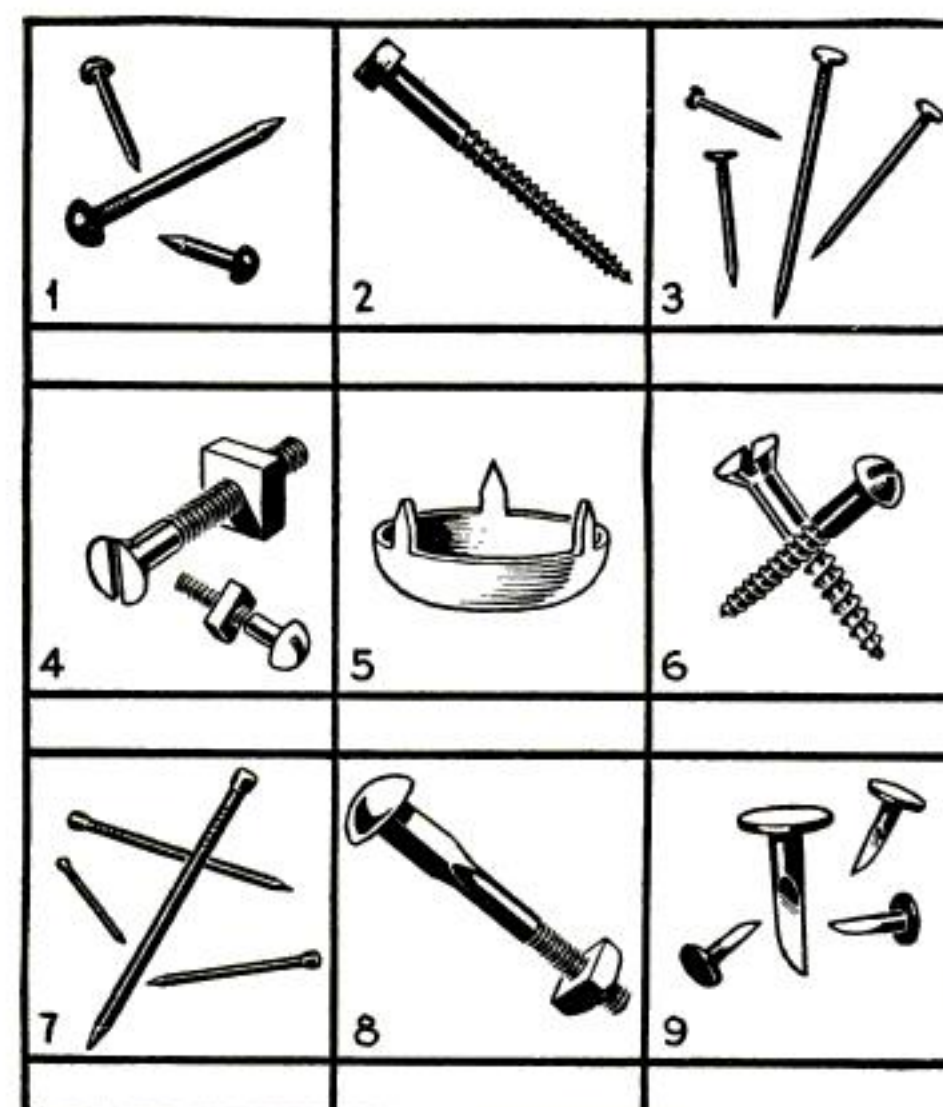
21 Hung from massive steel cables, the great Golden Gate Bridge at San Francisco is an outstanding example of (a) an arch bridge (b) a suspension bridge (c) a cantilever bridge.

22 Nonsense syllables like "dal," "bik," and "noor" have been found useful for (a) memory tests (b) helping poets to make lines rhyme (c) attempts to communicate with Mars.

23 Antimony is (a) money paid to a divorced spouse (b) a brittle bluish-white metal (c) the opposite of harmony.

24 A slide rest is used upon a (a) lathe (b) microscope (c) locomotive (d) plate camera.

25 No first-class meteorological observatory would be complete without (a) a marimba (b) a divining rod (c) a Bessemer converter (d) an anemometer (e) a hurricane deck.



You probably have used all these common articles of hardware. Can you match each picture with its name from the list below? Turn to page 129 for the answers

brad wood screw escutcheon pin
carriage bolt flat-head nail lag screw
carpet tack stove bolt furniture glide

Un-Natural History By GUS MAGER



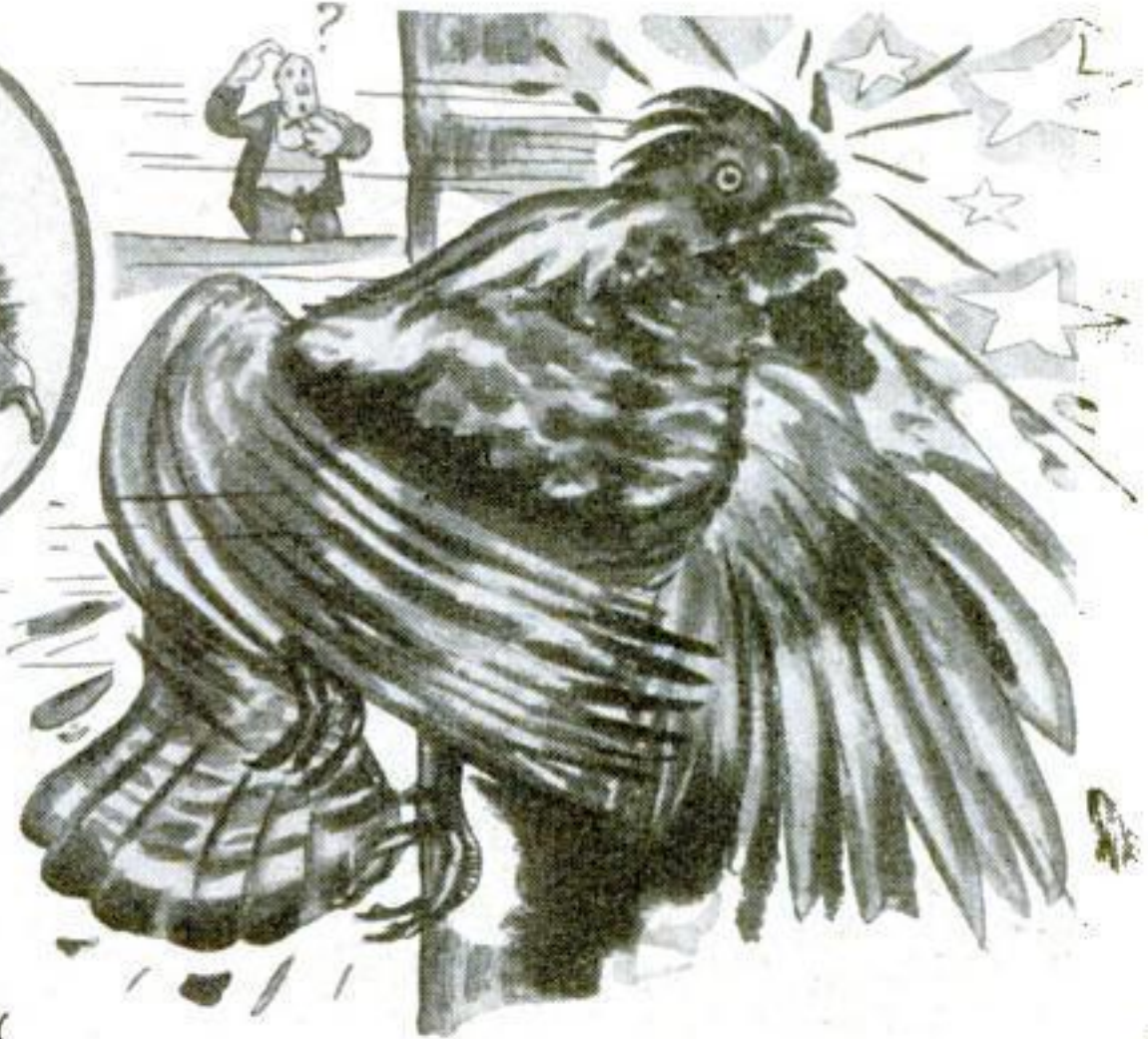
FROM FOUR FLOWERLIKE ROSETTES AT EITHER END OF ITS BODY, THE SINISTER-LOOKING LARVA OF THE AUSTRALIAN **STING MOTH** PROJECTS LITTLE BUNDLES OF BRIGHT-YELLOW POISON FILAMENTS THAT PRICK THE SKIN OF ANYONE WHO VENTURES TO TOUCH IT!



RUFFED GROUSE

GO "CUCKOO" IN THE FALL, MANY OF THEM KILLING

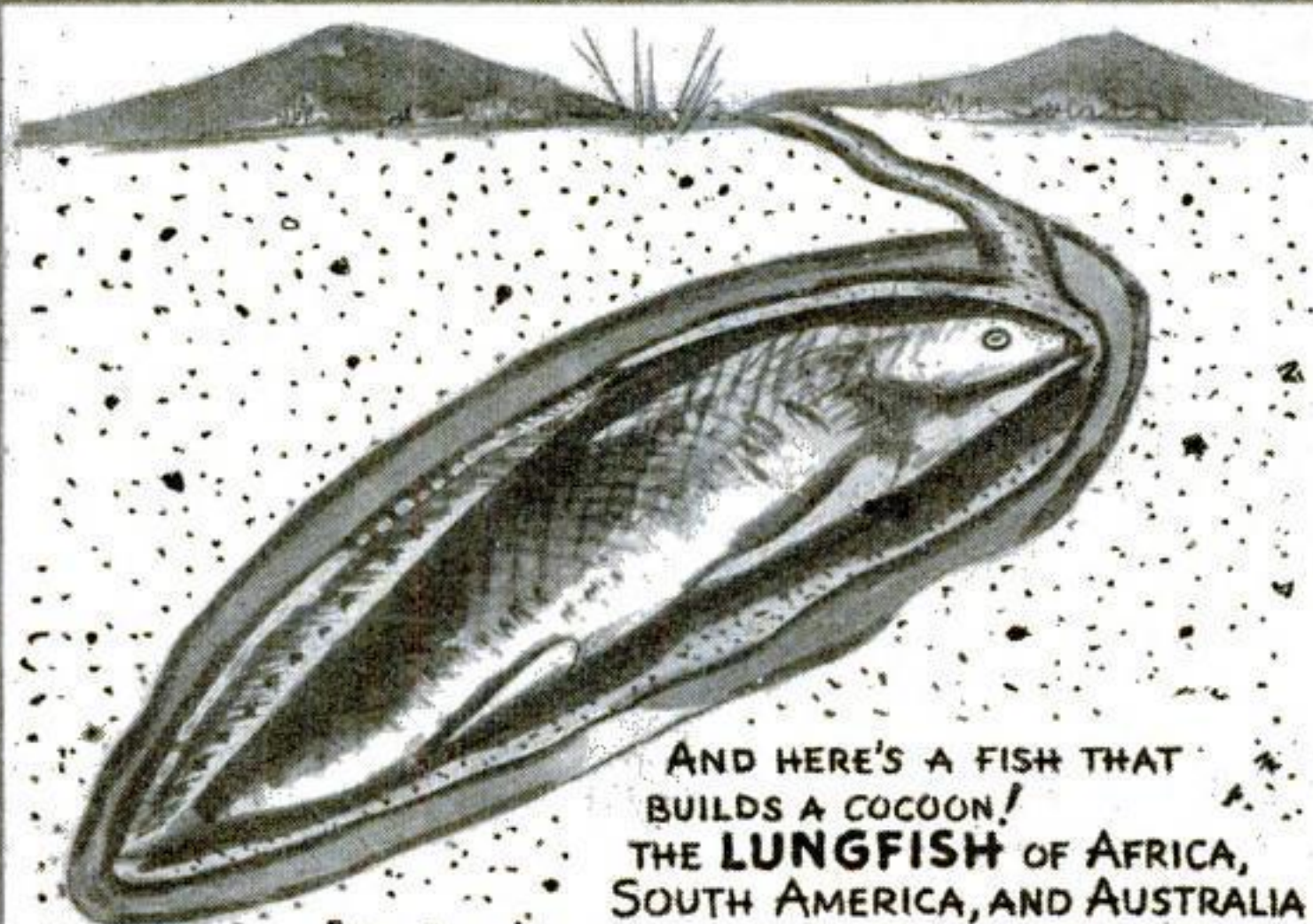
THEMSELVES BY FLYING STRAIGHT INTO WALLS, TREES, AND OTHER OBSTACLES! ANOTHER PECULIARITY OF THIS BIRD IS THAT WITH THE APPROACH OF WINTER IT GROWS SNOWSHOES—HORNY, COMBLIKE PROJECTIONS ON THE TOES THAT HELP TO SUPPORT ITS WEIGHT IN THE SNOW.



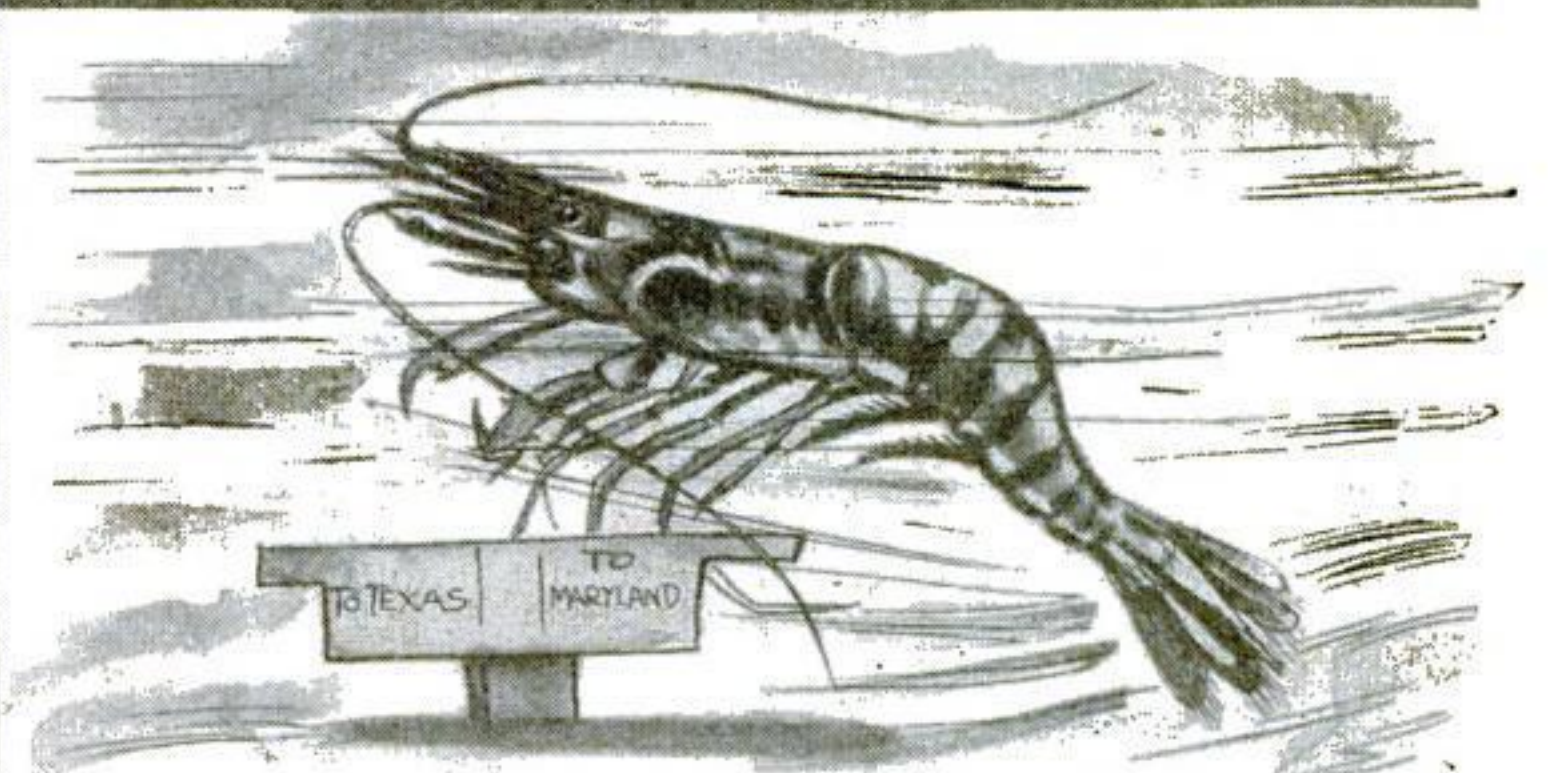
WHEN AN ANIMAL HAS A HEAD AND CUD LIKE AN OX, A BODY AND TAIL LIKE A HORSE, AND THE SLENDER LEGS OF A DEER—THAT'S **GNUS!** IN REALTY THIS PARADOXICAL AFRICAN CRITTER IS AN ANTELOPE IN GOOD STANDING!



THE MALE **ELEPHANT**, TOO, HAS A CRAZY SEASON! AT CERTAIN INTERVALS HE FEELS AN IRRESISTIBLE IMPULSE TO ATTACK AND DESTROY EVERYTHING IN SIGHT. THIS MYSTERIOUS BERSERK FIT IS CALLED "**MUST**"!



AND HERE'S A FISH THAT BUILDS A COCOON! THE **LUNGFISH** OF AFRICA, SOUTH AMERICA, AND AUSTRALIA INHABITS RIVERS THAT ARE OFTEN DRIED UP BY INTENSE HEAT. WHEN THIS HAPPENS, THE ODD FISH BURROWS DEEP INTO THE MUD AND MAKES A COCOON WITH SLIME FROM HIS OWN BODY! BREATHING THROUGH A LITTLE VENT TO THE SURFACE, HE CAN LIVE A YEAR OUT OF WATER, IF NEED BE!



WHO WOULD THINK THAT A POOR **SHRIMP** COULD TRAVEL 300 MILES IN THREE MONTHS UNDER ITS OWN STEAM? YET THE U. S. BUREAU OF FISHERIES HAS BEEN TAGGING SHRIMPS TO SEE HOW FAR THEY RANGE FROM THEIR SUMMER GROUNDS, AND DISCOVERED ONE WITH THIS REMARKABLE DISTANCE RECORD!

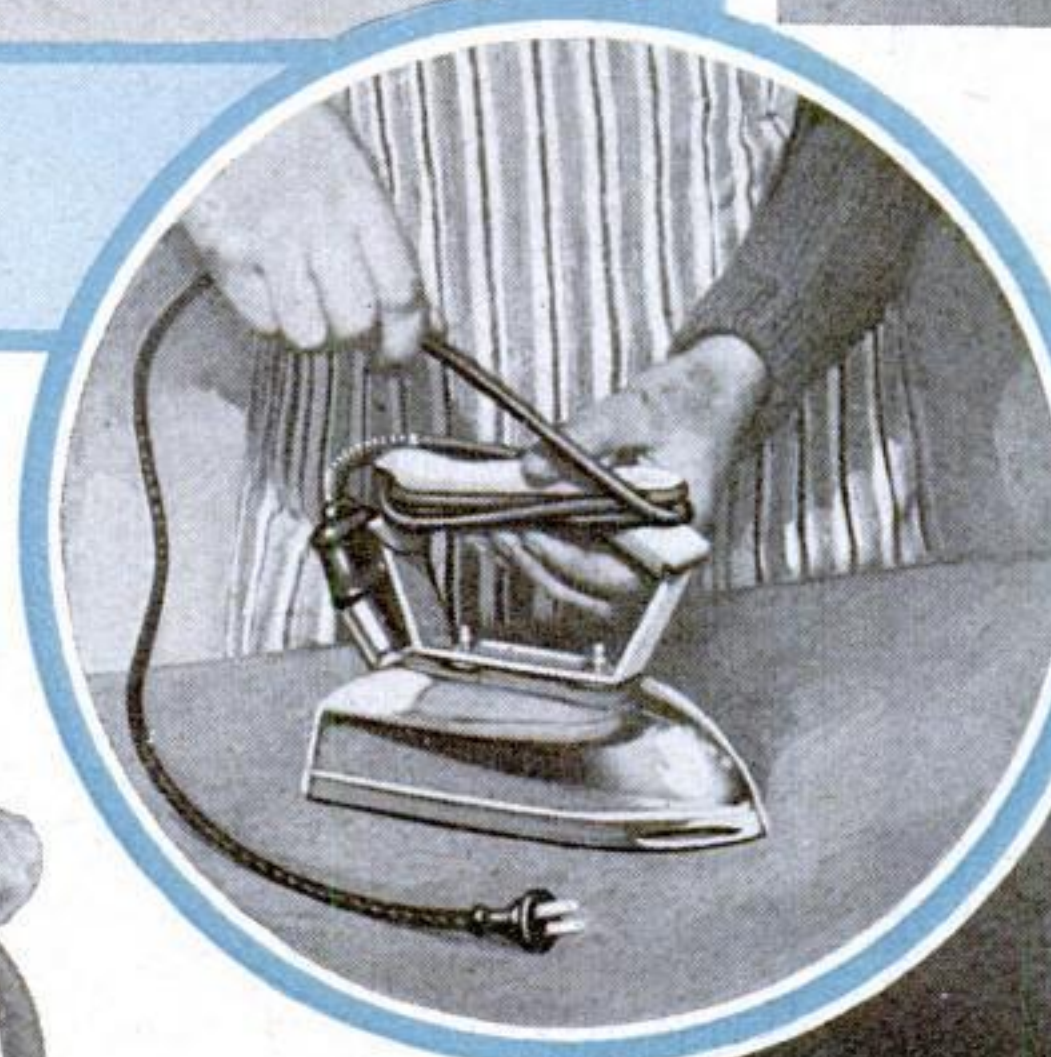
New Appliances



RADIO RANGE. Built into a new electric range, a radio receiving set tunes in on the day's programs



DICED VEGETABLES in an assortment for making fresh vegetable soup can now be purchased in one-pound cartons. The package has a window made of transparent material



HANDLE OF IRON HOLDS CORD
Specially shaped to form a reel, the handle of the electric iron at the left provides a handy place to store the cord



FRUIT JUICER

Whole lemons, oranges, and grapefruit can be placed in this device. A turn of the handle cuts the fruit and extracts all the juice



STENCIL FOR BIRTHDAY CAKE. "Happy Birthday" messages are easily inscribed on homemade cakes by the use of the stencil set demonstrated above



COCKTAIL SHAKER

Shaped like an old-fashioned town crier's bell, this new cocktail shaker makes it possible to mix drinks with an easy, ringing motion. The beverage is poured from the hollow handle, as pictured above

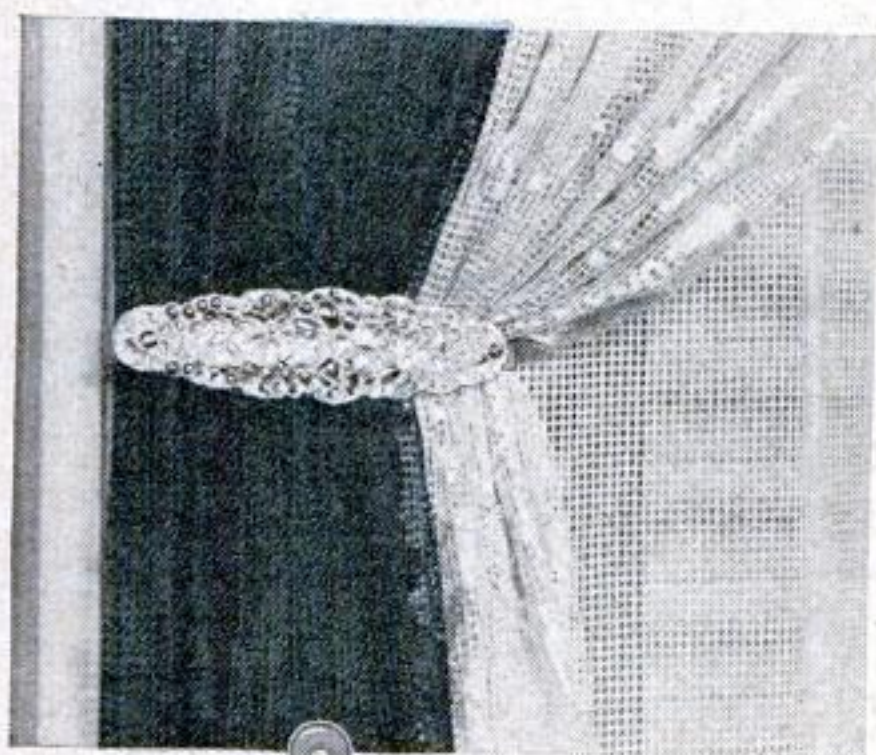


CLOTHESPINS OF RUBBER

Made of a nonporous rubber, the novel clothespin at the right is said to be unbreakable and more sanitary than the conventional kind made out of wood



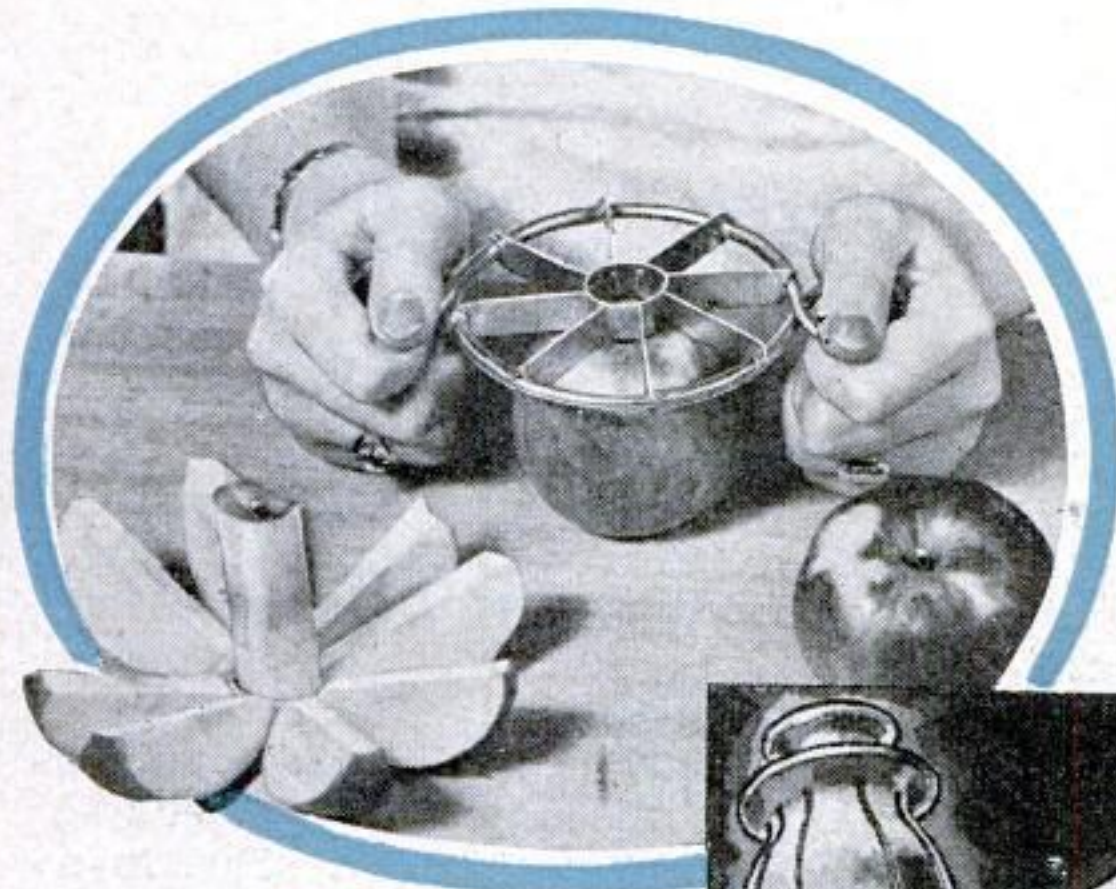
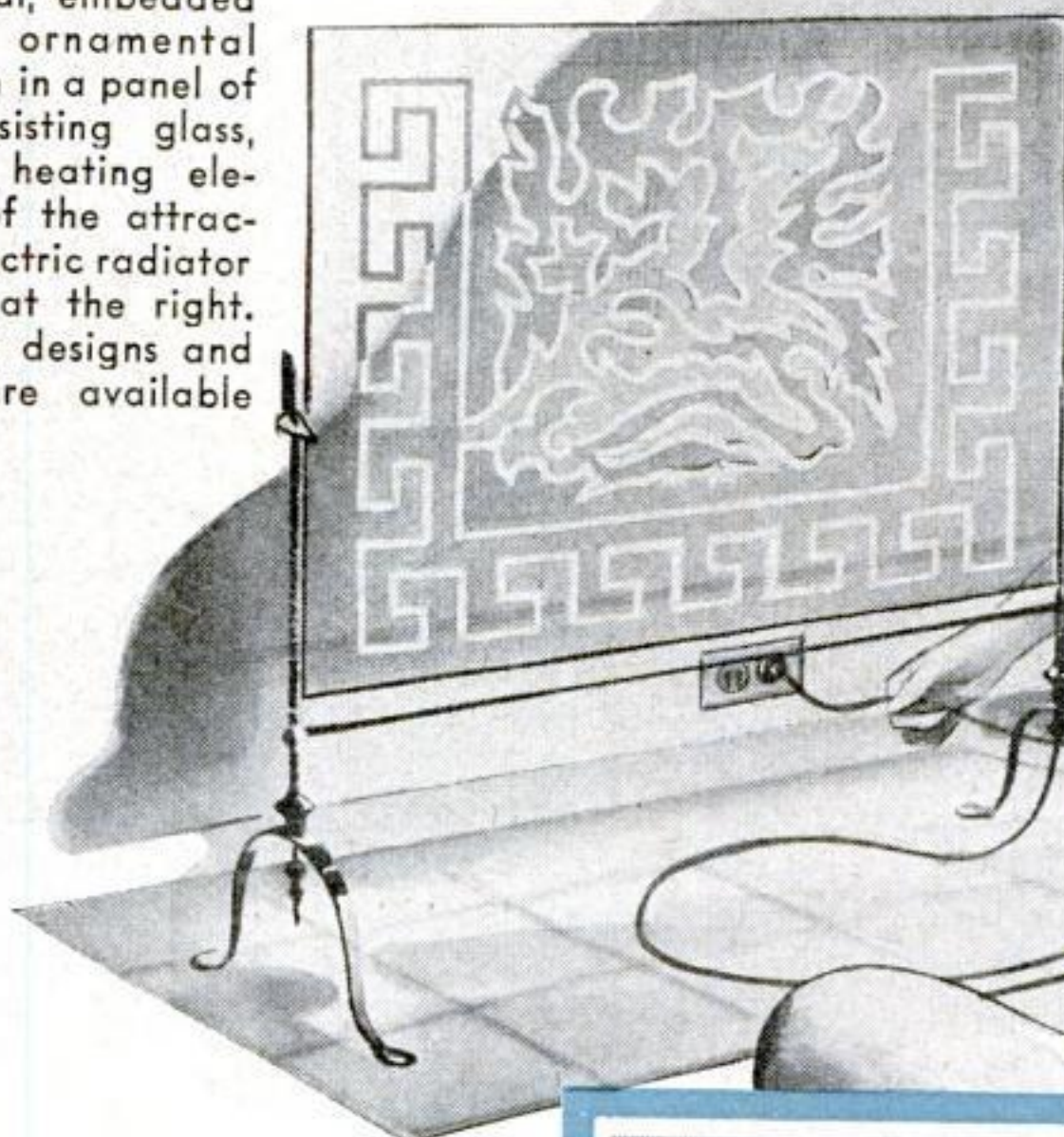
for the Household



NOVEL ELECTRIC HEATER. A ribbon of metal, embedded in an ornamental pattern in a panel of heat-resisting glass, is the heating element of the attractive electric radiator shown at the right. Various designs and sizes are available



CURTAIN TIE-BACK. Pleasing drape effects are obtained by the use of this curtain clip. The corrugated back retains folds and prevents bunching



TOOL SLICES AND CORES APPLES. An apple is sliced and cored in one operation with the handy tool at the left. It is merely placed on top of the fruit and pressed downward to produce eight even slices as illustrated



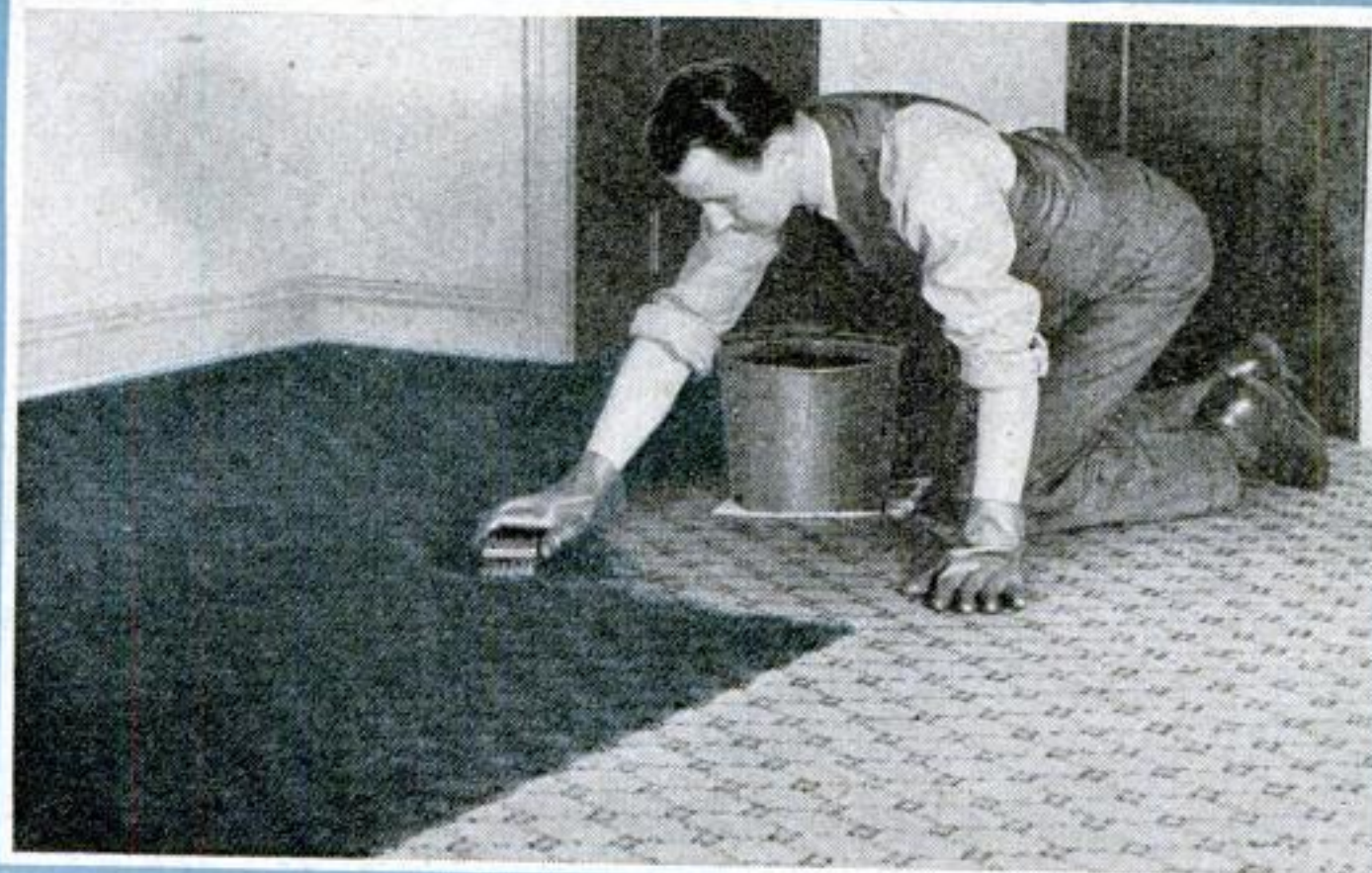
GUIDE FOR CUTTING
Placed over fruits, vegetables, and other foods, the novel device seen at the right guides a knife blade in cutting regular segments. It is specially useful for cutting oranges



CLOGPROOF SALT SHAKER
A pivoted blade on this new salt shaker loosens caked salt and allows it to be scattered over food



SPOON HOLDERS
Recesses in the handles of saucepans hold the stirring spoons so that they cannot soil tables or be mislaid



DYEING CARPETS
is made easy by the use of a new color-fast dye that is applied with a common scrub brush. The work can be done without taking up the carpet

GUS SAYS: Stop Your Starting Troubles

By MARTIN BUNN

THE neat little office of the Model Garage seemed especially bright and snug to Gus Wilson that evening. Outside, Old Man Winter was indulging himself in what probably would prove to be his last serious tantrum of the season. Gusts of snow, driven by a howling wind, swirled against the big front window.

Tilting his chair back against the warm radiator, Gus tamped down the glowing tobacco in the bowl of his pipe and grinned across at his partner, Joe Clark, who, as usual, had his head buried in a ledger. "In just about five minutes," he said, "that darned telephone is going to ring, and somebody's going to say that he's in trouble four miles down the road, and will we send the wrecker out and tow him in? And it's no night for a pleasure trip!"

"Well," answered Joe, "that's what we invested in a wrecker for, isn't it?" His horn-rimmed glasses glittered as he looked up from the ledger. "Say, Gus—here's a queer thing. You know that Henry Miller and George Knowles have cars of the same model, and that

they bought them at just about the same time. And they average about the same mileage—around 500 miles a month. Well, in the last year Miller has paid us more than twice—pretty near three times—as much for repair work as Knowles has. What's the answer?"

"The answer is that Knowles isn't married to Mrs. Miller," said Gus promptly.

"Huh?" asked Joe.

"Sure, that's the answer," insisted Gus. "Mrs. Miller drives quite a lot while Henry's busy down at his store, and she's not what I'd call a competent driver. She's one of those dames who slam a car around, and slamming a car around always gets into the repair bills sooner or later—generally sooner."

"Oh, women drivers aren't so bad, any more," said Joe.

"I didn't say that women are bad drivers—I just said that Mrs. Miller is a bad driver," said Gus placidly. "Some women know how to handle a car as well as most men. There's Peggy Knowles—she drives as much as Mrs. Miller does, and her driving doesn't cost her father anything but just for the gas and oil. But Peggy's been around this garage a lot—remember how she started coming over here for air for her bike tires when she was just a little kid?—and being a smart girl, she's learned quite a lot about cars. By the way, that sounds like that Knowles horn now!"

Gus walked over to the window and

looked out. "Yep, it's the Knowles car, all right," he said. "And it's pushing in a cripple." He pulled on his short overcoat, closed the office door carefully behind him, and slid open one of the garage doors. Snow drifted in onto the concrete floor as the Knowles car nudged the "cripple" gently into the garage. Then a young man wearing evening clothes and a frown got out of the first car, and a girl stuck her head out of the window of the other one.

"This is Jack Simpson, Mr. Wilson," she said, with a wave of her hand toward the frowning young man. "We're going to a dance at the country club. Jack came in to dinner, and when we went and got into his car, it wouldn't start. Dad's got to have our bus to take mother to her club meeting. Try to get Jack's car started for him, won't you please, Gus? I'll be waiting over at the house, Jack—make it snappy, or we'll miss half the fun. Good night, Gus!" Her car backed smoothly out into the storm.

Gus pushed the garage door closed, and looked at the frowning young man. "Got any idea what's wrong?" he asked.

"Of course!" snapped Simpson. "My battery has run down, somehow. Got a rental you can stick in?"

"Yep, we've got rentals," grunted Gus. He got into the car and pulled the light switch. The lights came on, but rather dimly. Then he stepped on the starter. Nothing happened.

"It's the battery, I tell you!" snapped Simpson. "It's been getting weaker and weaker for the past week. Put in a rental, will you, so that I can get going!"

Gus looked at him steadily for a couple of seconds. Then he shrugged his big shoulders. "I'd hate to have Peggy Knowles miss her dance," was all he said. He walked away, came back with a rental battery, and swiftly substituted it for the one in the car. "There's your rental," he said briefly. "I'll have your battery ready for you any time after four tomorrow afternoon."

"Thanks!" said Simpson. He jumped into his car, and jerked the light switch. The lights flashed on. "That's better!" he said. Then he kicked the starter. And again nothing happened.

Gus grinned at him. "I've been in this business long enough to learn that before you start fixing anything it's a good idea to find out what's wrong," he remarked. "Hop out and I'll try to find out what's the matter with this job of yours—and to start her rolling before Peggy gets on the phone (Continued on page 131)

"Jack came in to dinner, and when we went out and got into his car, it wouldn't start."



Electric Hotbeds

GIVE A GARDEN
AN EARLY START

By Kendall Ford

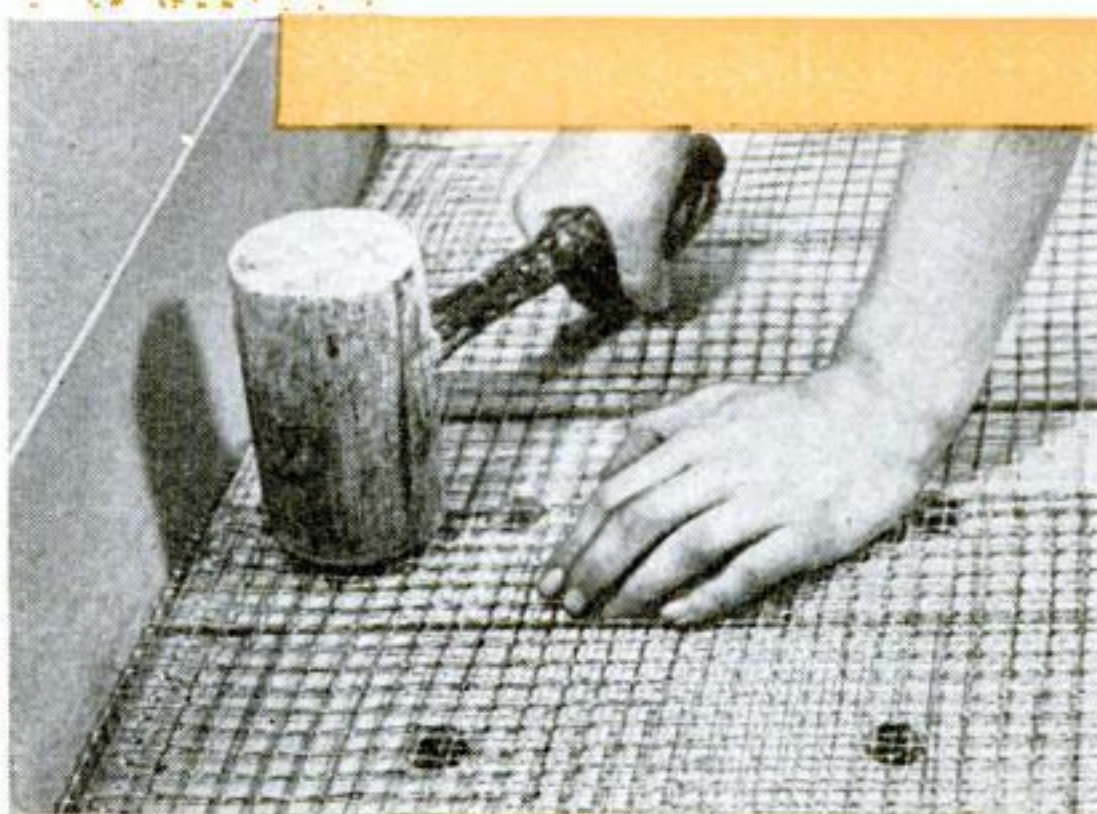


BY MEANS of electrically heated hotbeds, flowers and vegetables may be grown out of season at rates of growth that far surpass even the best results obtained by ordinary greenhouse methods. That is because the heat may be applied to the soil at any depth and held at a constant temperature with a thermostat.

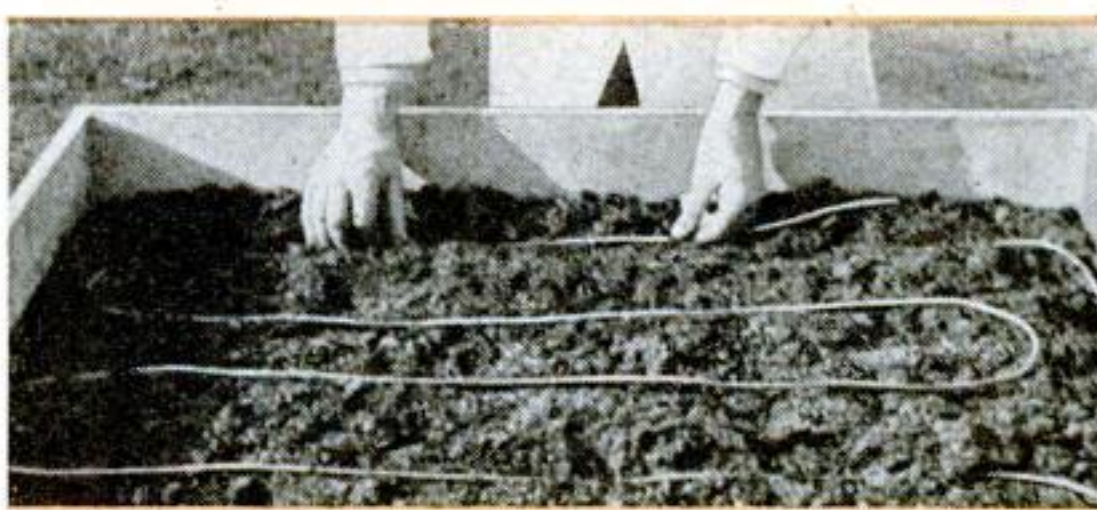
A hotbed such as that illustrated may be built at surprisingly low cost. Odd sizes of salvaged lumber and sash frames may be used for the box, and the electrical equipment is inexpensive. In the writer's locality (Los Angeles, Calif.) the cost of operation is less than that of a 100-watt lamp. The current consumption in maintaining a temperature of 70 deg. under actual growing conditions over a period of one month was 20 kilowatts. At $3\frac{1}{2}$ cent. a kilowatt-hour, the cost for the month was only 70 cents.

The heating unit covers an area of about 16 square feet, but the size of the hotbed will be determined by the sash available. The writer obtained one 3 by 4 ft. from a salvage lumberyard. The height of the box may vary, but should have a slope not less than that shown in Fig. 22. Use well-seasoned wood, fasten the pieces with screws, and reinforce the corners with sheet-metal angles.

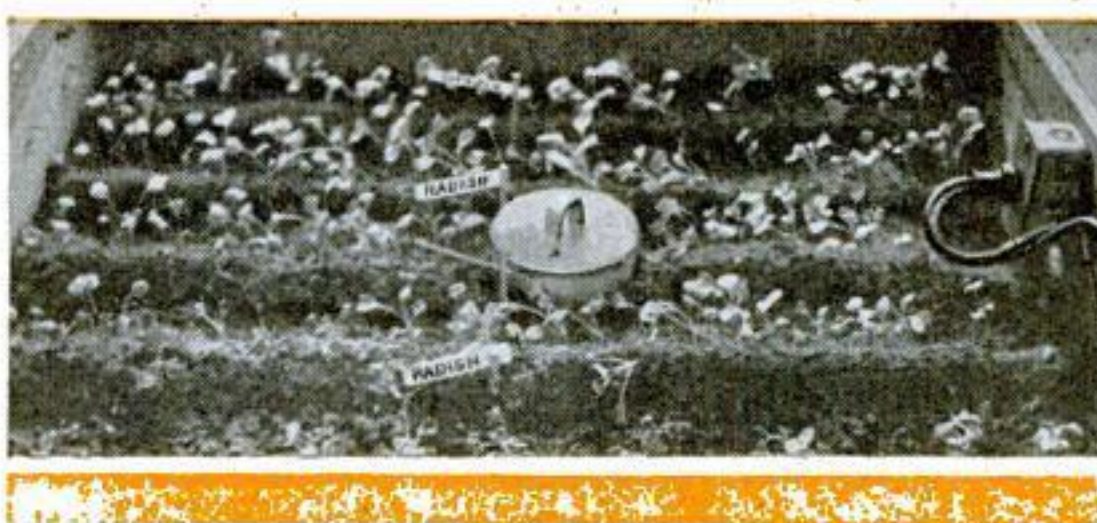
The thermostat is built around an element used in chicken brooders and incubators, which may usually be obtained from dealers in poultry supplies for 60 cents or less. These units consist of hollow brass disks or wafers containing a chemical that expands



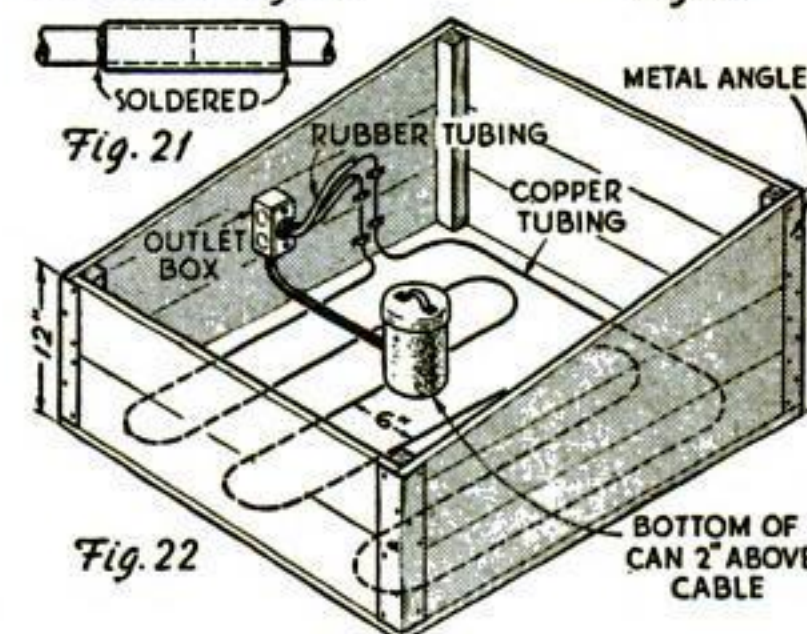
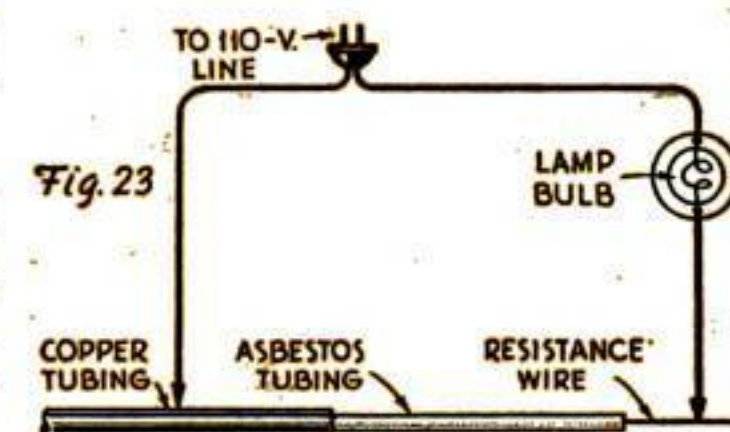
The bottom of the box is covered with wire mesh or screen after drainage holes have been bored



A layer of soil about 1 in. deep is spread in the box, and over this the heating cable is arranged



Plants sprout up like magic in this hotbed, which is electrically heated. A thermostat controls the temperature



The general arrangement, details of cable, and how wire is tested for a "ground." For clearness, the lower figure numbers have been reserved for numbering the thermostat parts

when heat is applied. They may be obtained with either plain or threaded center studs. The latter type is easier to assemble.

The element support is a piece of pipe, Fig. 1. Drill, tap, and cut a flat piece of 3/16-in. metal to shape as in Fig. 2. The saw slot is for varying the tension on the adjusting screw. Thread and shape a piece of 1/4-in. metal rod as in Fig. 3, and tap one end to fit the threaded stud on the element. If the element has a plain stud, the hole may be drilled to fit and the two soldered together if care is taken not to melt the solder on the element.

Mount the element support on a wood base, Fig. 14, with a 3 by 3/16-in. machine screw. (The complete thermostat assembly is shown in Figs. 15 and 16.) Cut the scale holder, Fig. 5, from No. 20 gauge sheet metal, and drill 1/8-in. holes where indicated. Cut a thin tin pointer as in Fig. 4, bend and drill, and bolt to the scale holder. Place a washer back of the pointer so that the point will clear the temperature chart when it is bolted in place. Solder the holder to the element support arm, Fig. 2, so that the right-angle section of the pointer will rest on the rounded end of the adjusting screw, Fig. 3.

Cut and drill a piece of No. 26 gauge spring brass or phosphor bronze as in Fig. 6. Shape two silver contacts as shown in Fig. 7. These

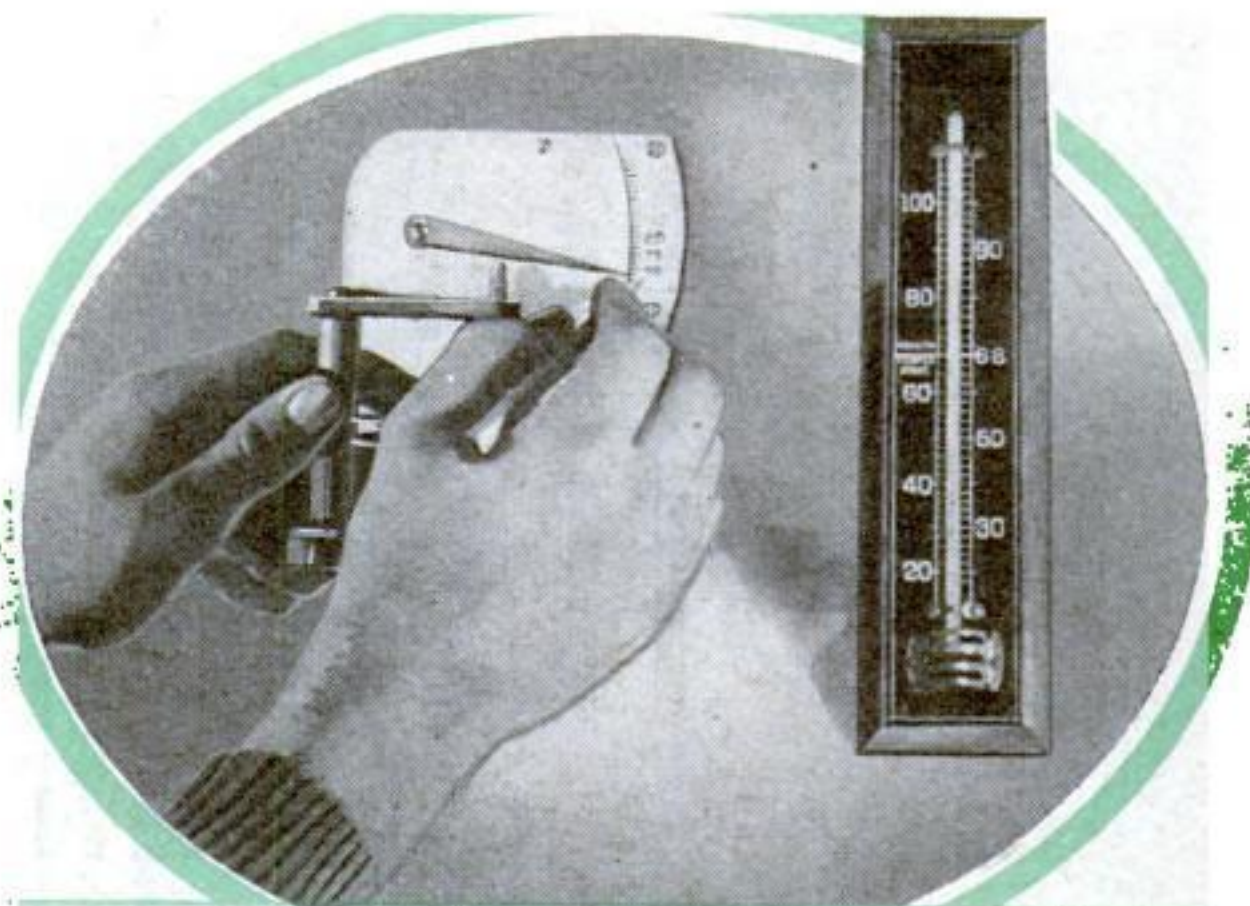
contacts may be from 1/8 to 3/16 in. in diameter, and the silver rod for making them may be obtained from a local jeweler for a few cents, or ignition breaker points may be used. Solder one contact to the spring strip, Fig. 6, and the other to the end of a threaded rod, Fig. 9.

Drill and tap a piece of 1/2-in. square metal, Fig. 8, and mount it on the wood base with a No. 10-24 machine screw. Secure the contact strip, Fig. 6, to the square post with No. 4-40 machine screws. Cut a piece of 5/16 by 1-in. metal tubing for the adjustable contact support, Fig. 10. Prepare a piece of 1/4-in. square brass as in Fig. 11, and drill and tap it. Mount the

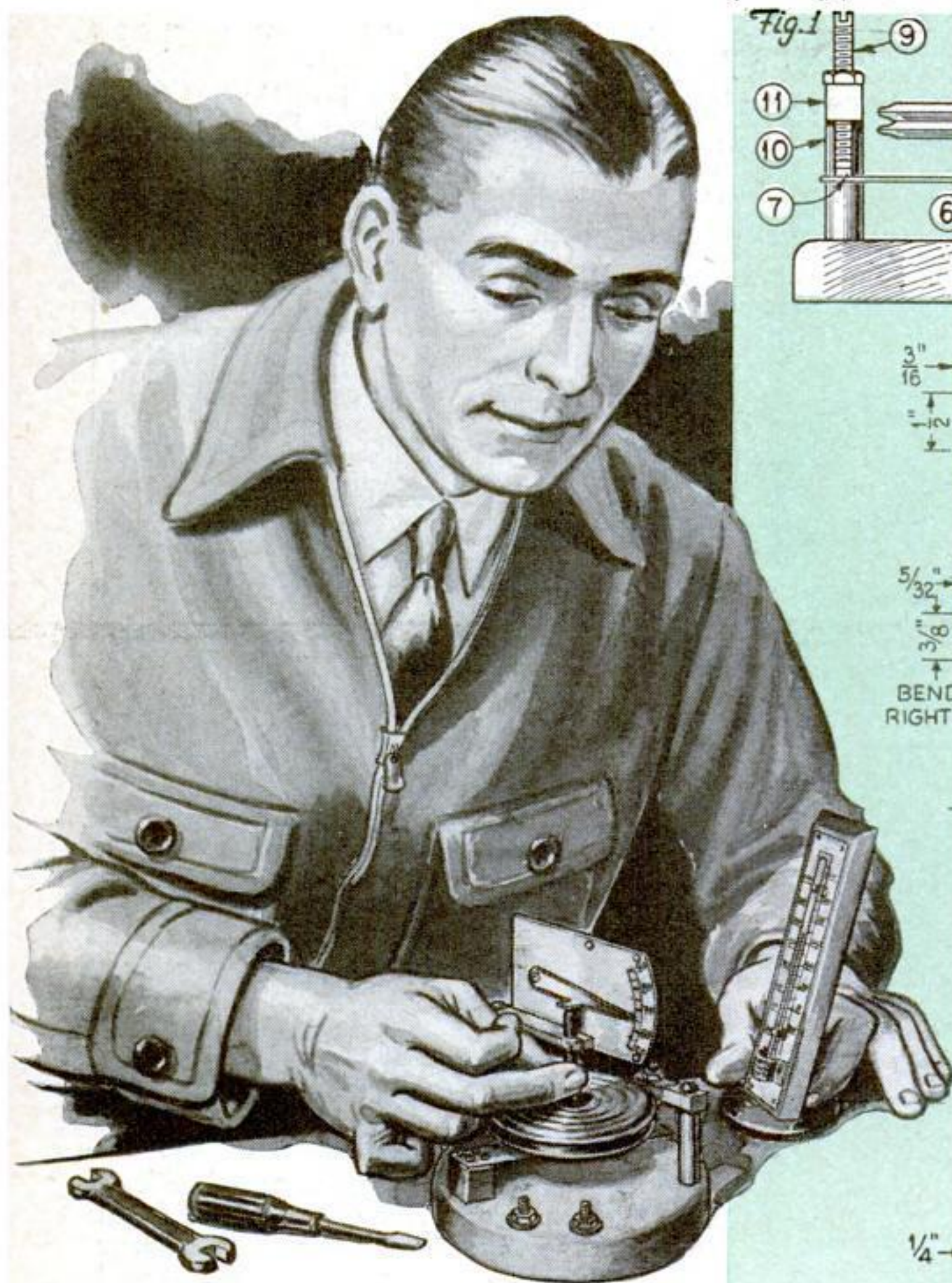
two pieces on the wood base with a No. 8-32 machine screw.

Drill a piece of 1/4-in. round fiber, 3/8 in. long, to fit the lower stud of the thermostat element. Provide two terminal screws in the holes indicated in Fig. 14, and make connections as shown by the dotted lines.

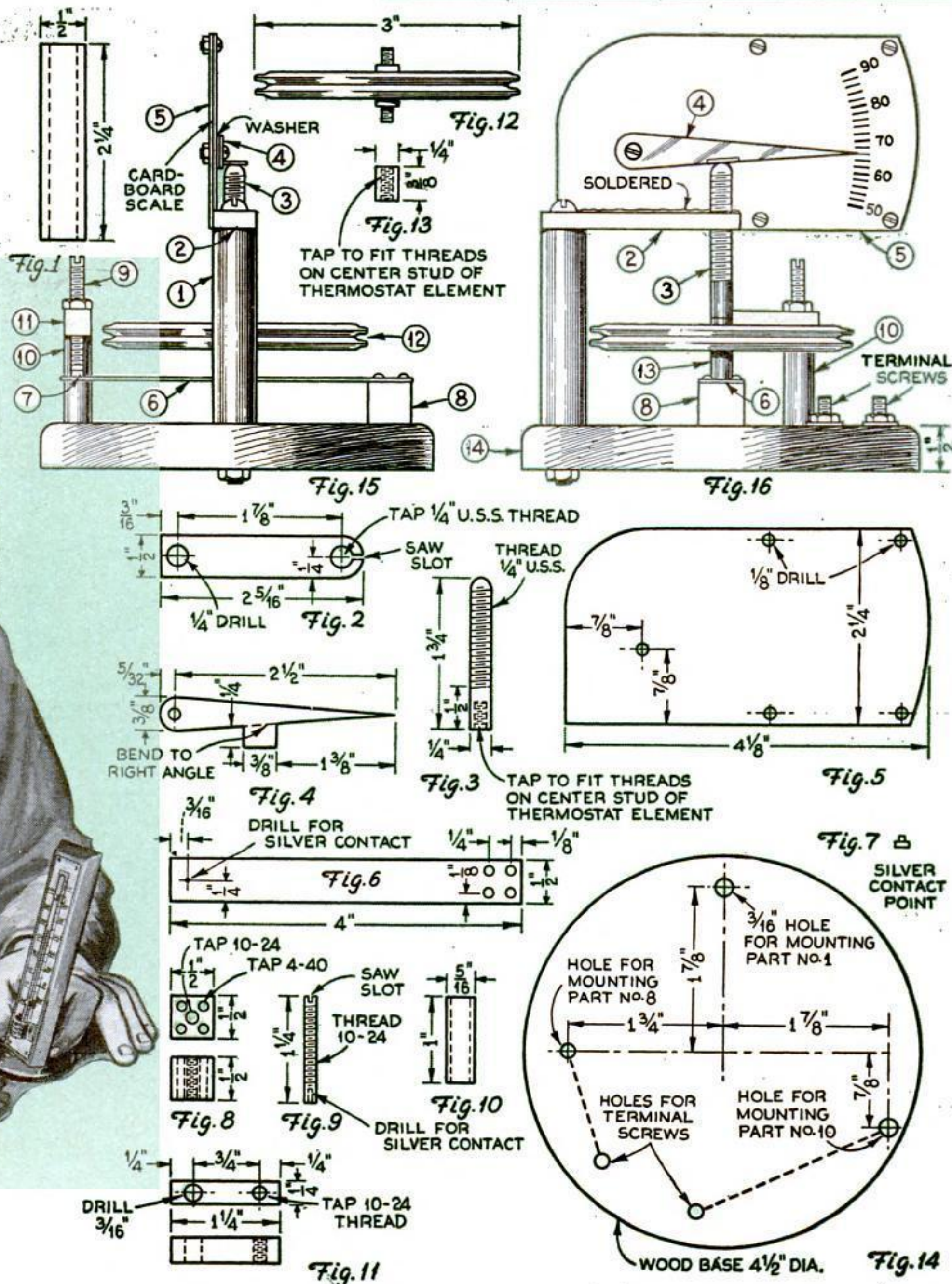
Secure white cardboard to the chart holder, Fig. 5, and mark in equal divisions 1/16 in. apart as in Fig. 16. Place

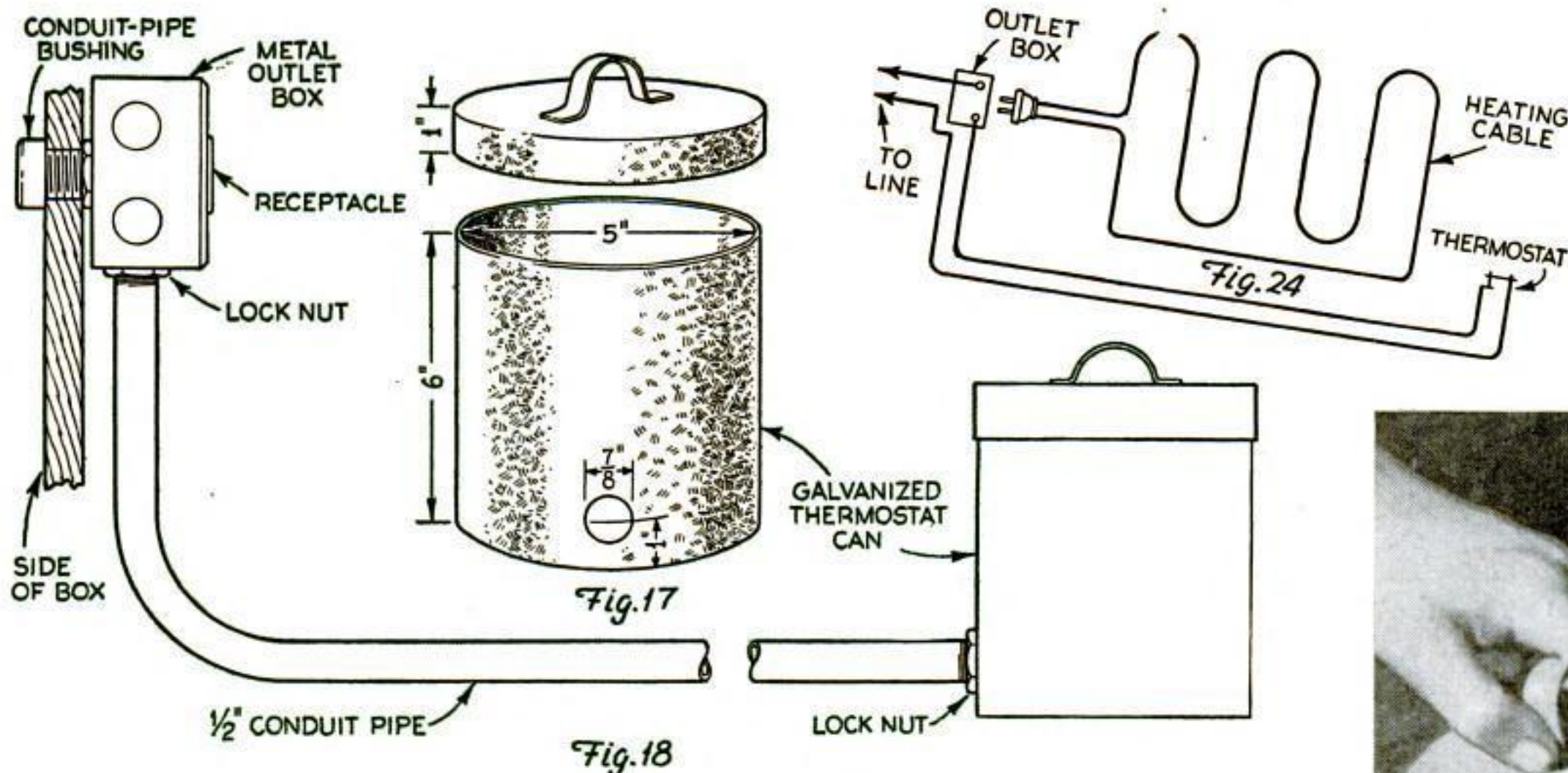


Right, the thermostat element is calibrated by comparing it with an ordinary thermometer at various temperatures. The scale is marked on cardboard as shown in Fig. 16 of the drawings below



The thermostat unit is built around an inexpensive, wafer-like element used in chicken brooders and incubators, which expands greatly if heated





The can containing the thermostat is placed in the center of the hotbed with its upper part above the earth, as shown below. The cover may be lifted off when necessary to adjust the thermostat

The thermostat can, conduit, and receptacle; and, at right above, the wiring diagram

the wafer unit in position so that the fiber will just rest on the contact spring. With the exception of the spring contact strip and the contact points, all the metal parts may be either brass or iron.

When the thermostat has been assembled, it may be calibrated with the aid of a thermometer. Adjust the contact screw so that a slight turn of the cylindrical element will barely open the contacts, and note the temperature reading of the thermometer. Mark the temperature on the cardboard directly opposite the pointer. Place the unit and thermometer in various locations having a range of temperatures at which it is desired to operate the hotbed, and record the temperatures on the chart. Under normal conditions a temperature range of 60 to 80 deg. will be sufficient. If the bed is to be operated as a so-called "cold frame," in which the thermostat is set to operate at a few degrees above the freezing point, the calibration may be easily carried down to the lower temperatures.

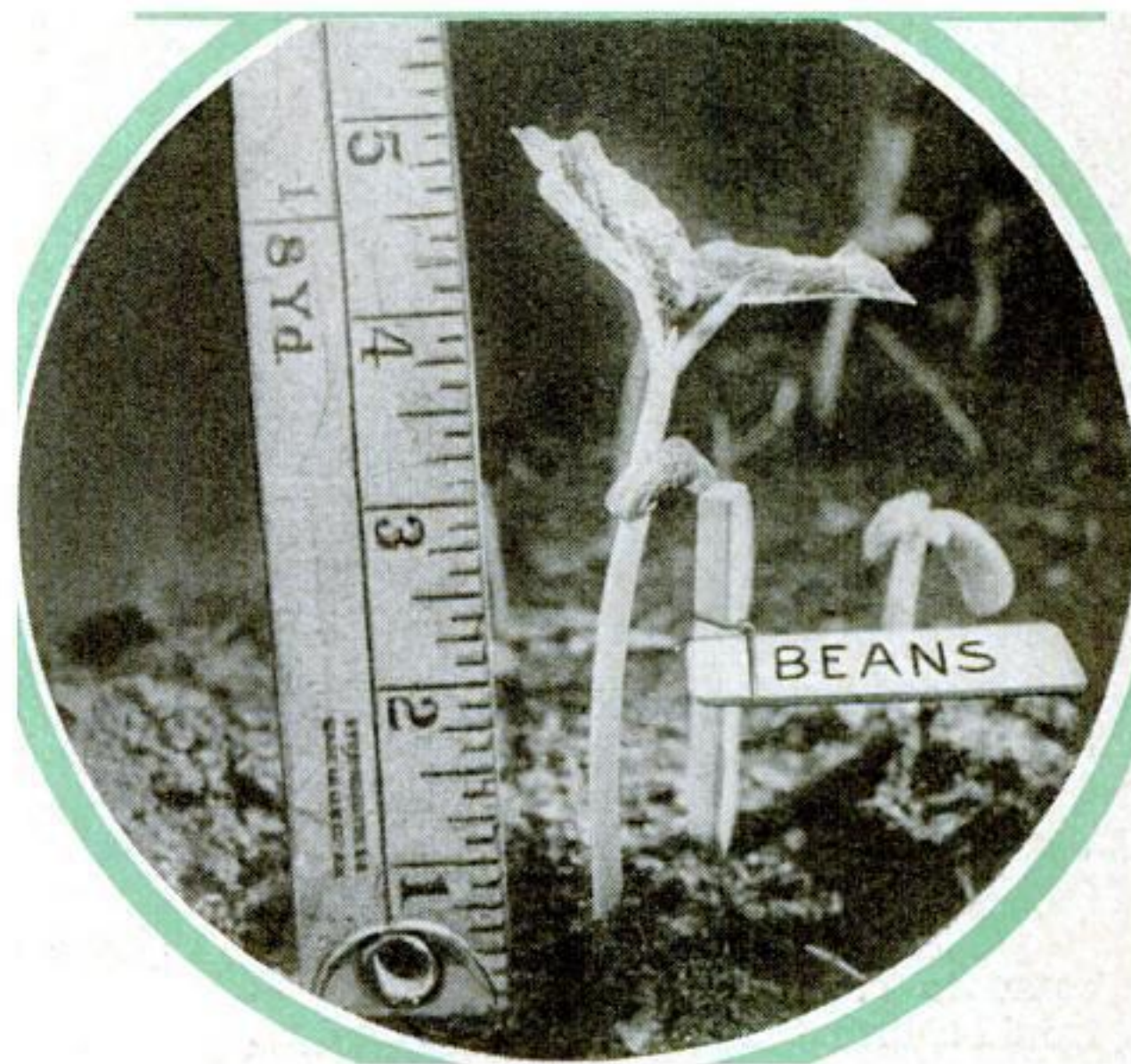
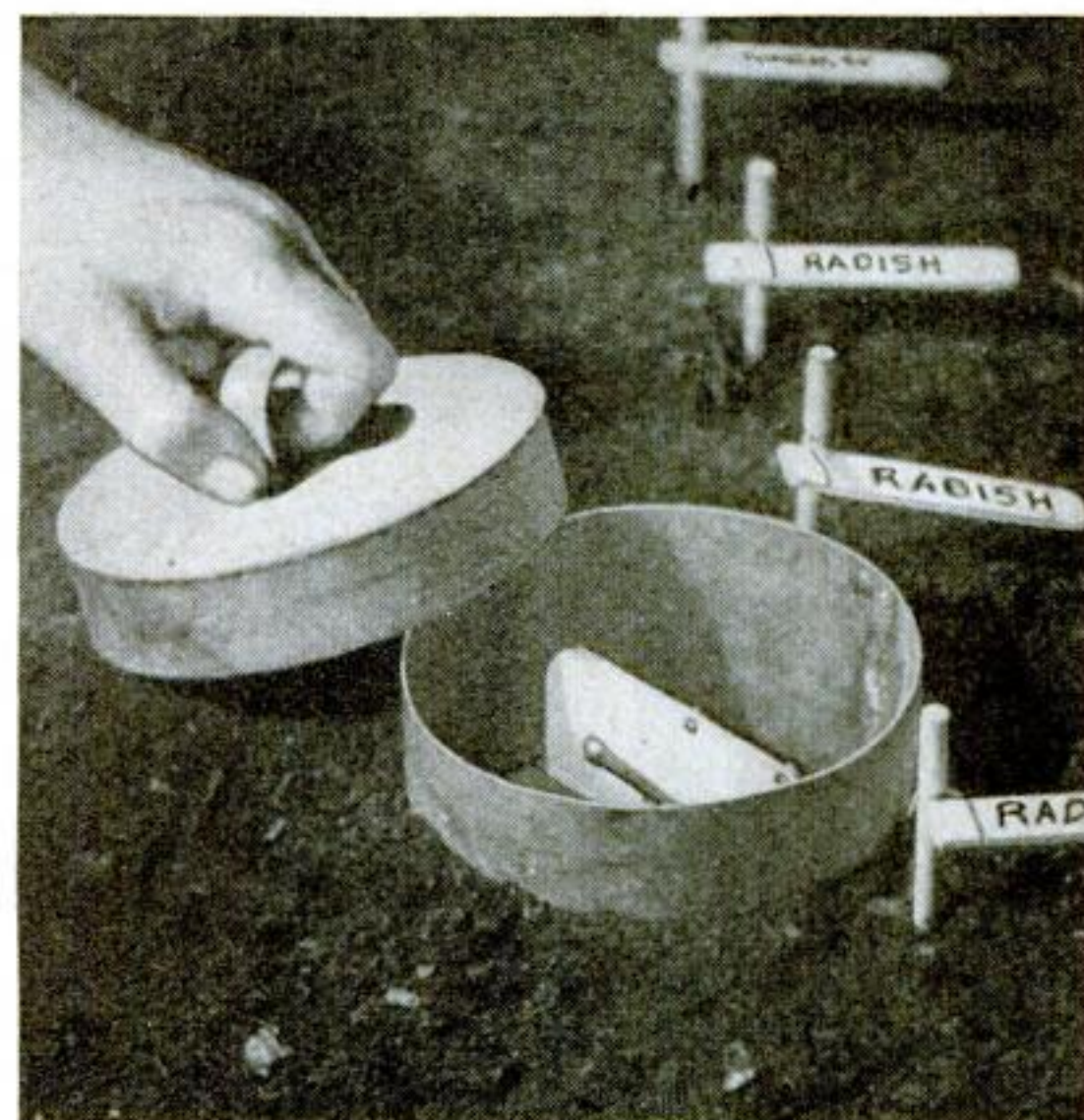
Make a galvanized metal can to house the thermostat, as shown in Fig. 17, and connect the can to a metal electrical outlet box with a piece of 1/2-in. conduit as in Fig. 18. Provide a short piece of pipe in the back of the outlet box to carry the supply wires through the hotbed wall. The pipe between the thermostat can and the outlet box should be of sufficient length to allow the can to be installed in the center of the hotbed, although this should not be done until the heating cable is in place.

For the heating cable, 25 ft. of 1/4-in. copper tubing, 30 ft. of 1/8-in. asbestos tubing, and 35 ft. of No. 30 nichrome resistance wire will be required. The copper tubing may be obtained in one piece in automobile accessory stores, or

in shorter sections at automobile wrecking yards. Thread the resistance wire through the asbestos tubing, taking care to avoid kinking the wire. If a heavier wire is threaded through the asbestos tubing first and used to draw in the smaller wire, the job will be quite easy. Then thread the resistance wire and asbestos tubing through the copper tubing, but secure the end of the asbestos tubing so that it will not unravel.

Double back the ends of the resistance wire and twist together so that the length of wire extending beyond the copper tubing will be a double strand as in Fig. 19 (on the opening page). This is to prevent the wire from heating between the end of the copper tubing and the point where it is attached to the plug cap. While the ends of the resistance wire are being twisted, the wire may be drawn partly out of the tubing, then pulled back. Care should be taken that the free end of the twisted wire does not protrude through the asbestos tubing and cause a "ground." As a precaution, it is advisable to test the cable as in Fig. 23. If the lamp lights, it indicates that the wire is touching the copper tubing.

If short sections of copper tubing are used, the ends should be reamed as shown in Fig. 20 and joined with a sleeve, Fig. 21. The joints must be perfectly water-tight.



Bean plants four days after the seed had been placed in the box. In nine days the plants were almost 8 in. high

Bore drainage holes in the bottom of the box and cover the bottom with a layer of wire mesh or screen. Place a layer of soil 1 in. deep and lay the cable as shown in Fig. 22. The parallel strands of cable need not be brought closer together than 6 in. and may be separated farther to cover areas up to 16 square feet.

Install the metal thermostat can and metal outlet box and connect as shown in Fig. 24. Before placing the thermostat in the can, set a disk of fiber or thin, dry wood in the bottom of the can for insulation.

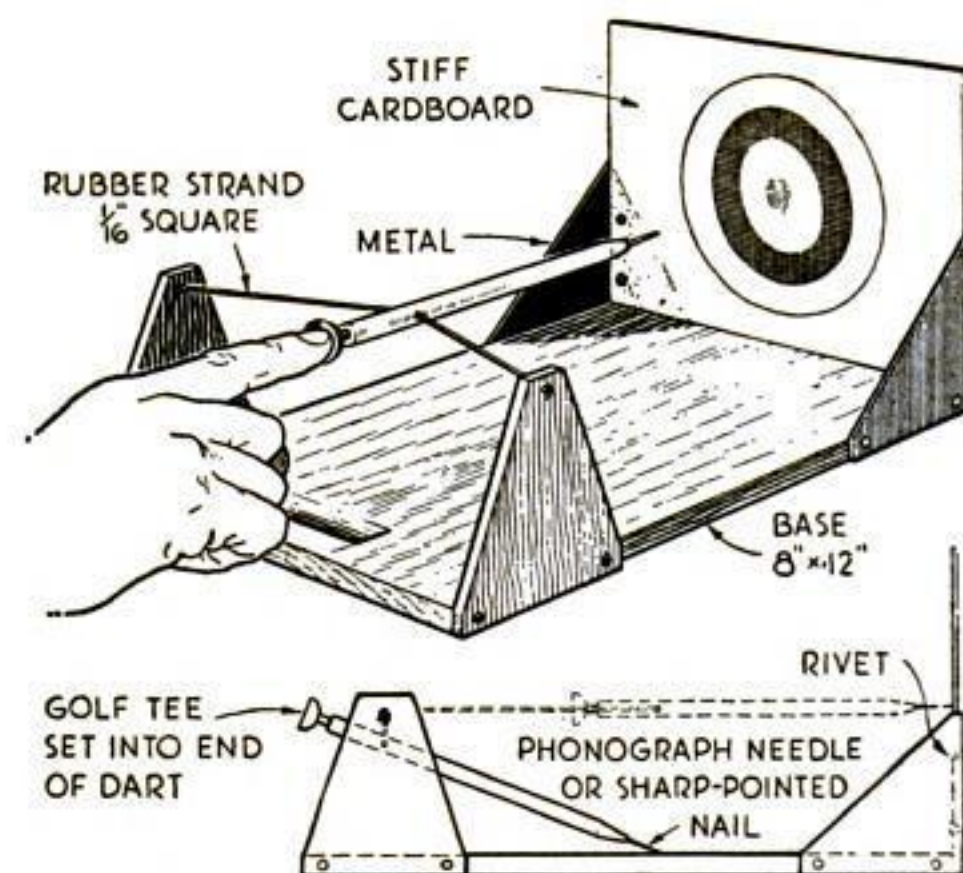
In locations where temperatures run exceedingly low, insulation in the form of layers of newspaper around the box will aid materially in reducing the amount of current required. The soil may have a depth of from 6 to 8 in.

**YOU CAN GET A NEW THRILL FROM GARDENING
BY CONSTRUCTING AN ELECTRICAL HOTBED . . .
CURRENT IS CONSUMED ONLY FOR A SMALL PART
OF EACH DAY, SO THE EXPENSE IS NOT GREAT**



Piano Wire Splits Lead Pipe in Straight, Even Line

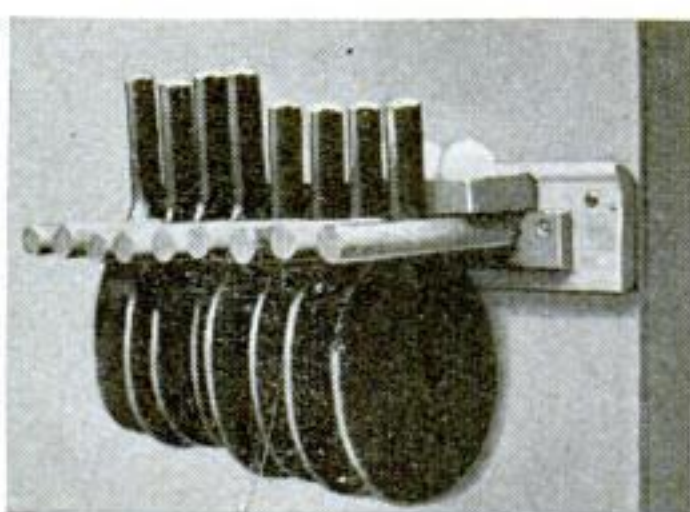
SPLITTING lead pipe on a straight line is never an easy task, but it can be neatly done with a piece of piano wire about 10 in. long. Form a loop in each end of the wire. Two pieces of cord slightly longer than the pipe to be split are also needed; tie one of these in each loop of the wire. Thread one cord through the lead pipe, place the other on the outside, and bring the ends together at the upper end. See that the piano wire is properly aligned. A steady pull will then cause the wire to cut the pipe evenly. A mark can be made, if desired, and the cutting wire guided along it by the direction of pull. The smaller the wire, the easier it will cut the pipe, and in no case should it be larger than music wire No. 4.—RAY BLAIN.



New Target Game Uses a Captive Dart

"WIGGLE DART," an entertaining marksmanship game, has a captive dart instead of the free type. The construction is made clear in the drawings above. The bullseye of the target is painted red, the next ring white, the third blue, and the last white. You may have to replace the target from time to time.

The object is to stick the red bullseye, which is far from easy to do. The index finger is placed in the dart cup so that merely the tip touches it, and the whole game is held up with the fingers of the other hand by means of the pocket or slot in the base. Players may give values to the various rings and keep score.—DONALD W. CLARK.



Rack for Holding Table-Tennis Paddles and Balls

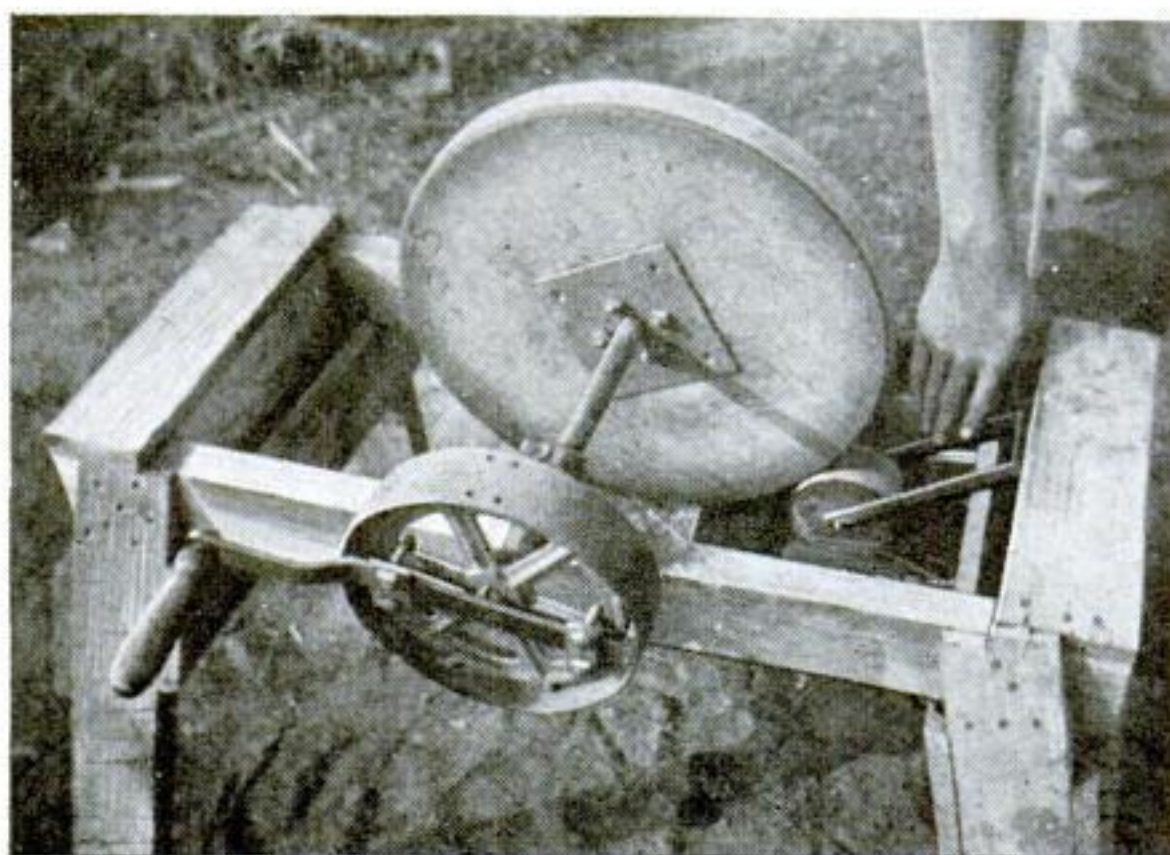
A HOLDER for table-tennis paddles and balls may be made as illustrated from scrap lumber and an old broom

handle. The pieces of broom handle are spaced just far enough apart to permit the blades of the paddles to slip between them easily. Cotton mosquito netting, if stretched on light frames, makes cheap but excellent backstops and side walls for table tennis and does not cut off ventilation.—BERTRAM BROWNOLD.

Water Glass Hung on Peg for Sanitary Reasons



HANGING a drinking glass on a wooden peg as shown rather than standing it on a shelf has several advantages. The glass drains well; the rim does not come in contact with anything as it would if inverted on a shelf; and no dust can settle in the glass as would be the case if the glass were placed open end up.



Grindstone Watered by a Felt Roller

WATER is supplied to this grindstone by a felt-covered wooden roller held against the stone by the tension of a light spring. The felt is fastened on the roller with brass or copper tacks. The bracket that holds the device is stapled to the frame in such a position that the roller runs in a trough of water as shown.—NORVAL WRIGHT.

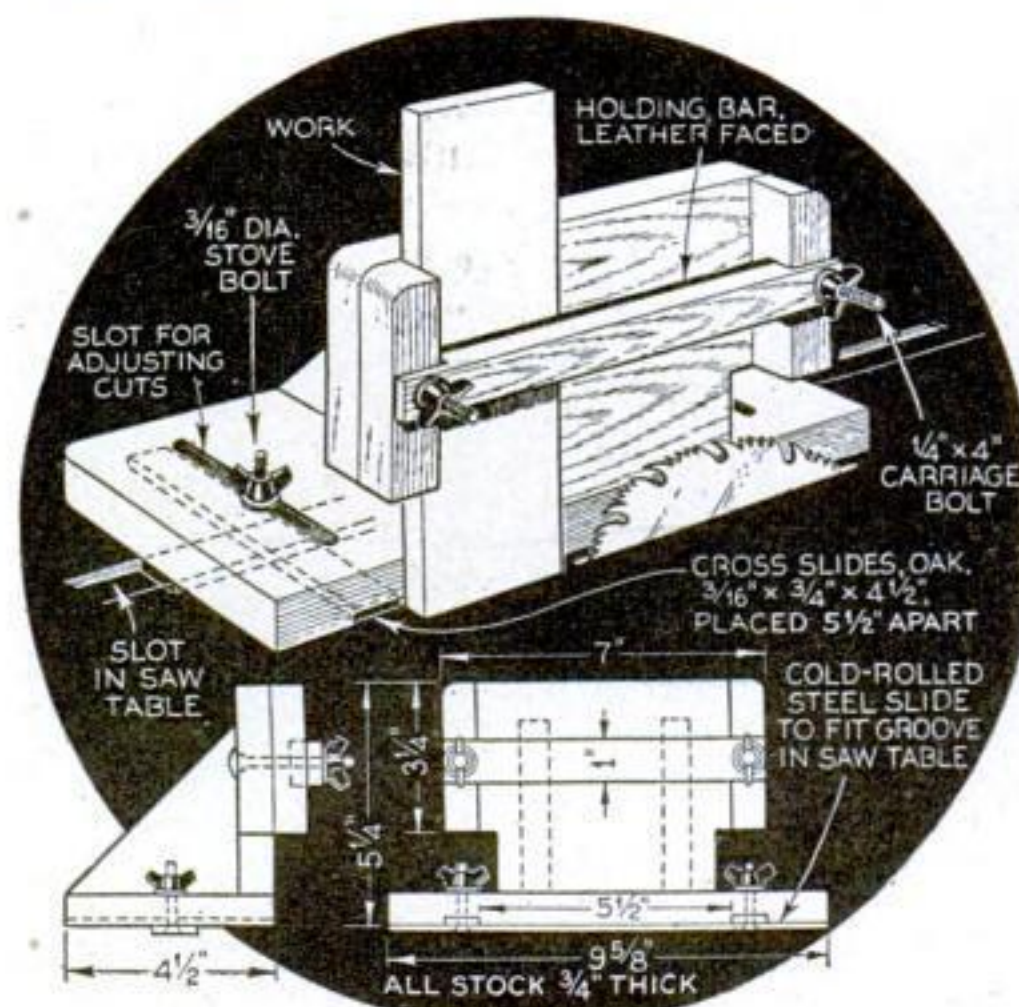
Adjustable Jig for Tenoning on a Circular Saw

CUTTING tenons on the circular saw, especially on the ends of narrow and comparatively thin furniture rails, is an operation that troubles many amateur woodworkers. Since the guard has to be removed from the saw and the stock held in a vertical position, there is a certain element of hazard not present in ordinary work that is held flat on the saw table.

Excellent tenon-cutting jigs are sold, but a substitute can be devised if necessary.

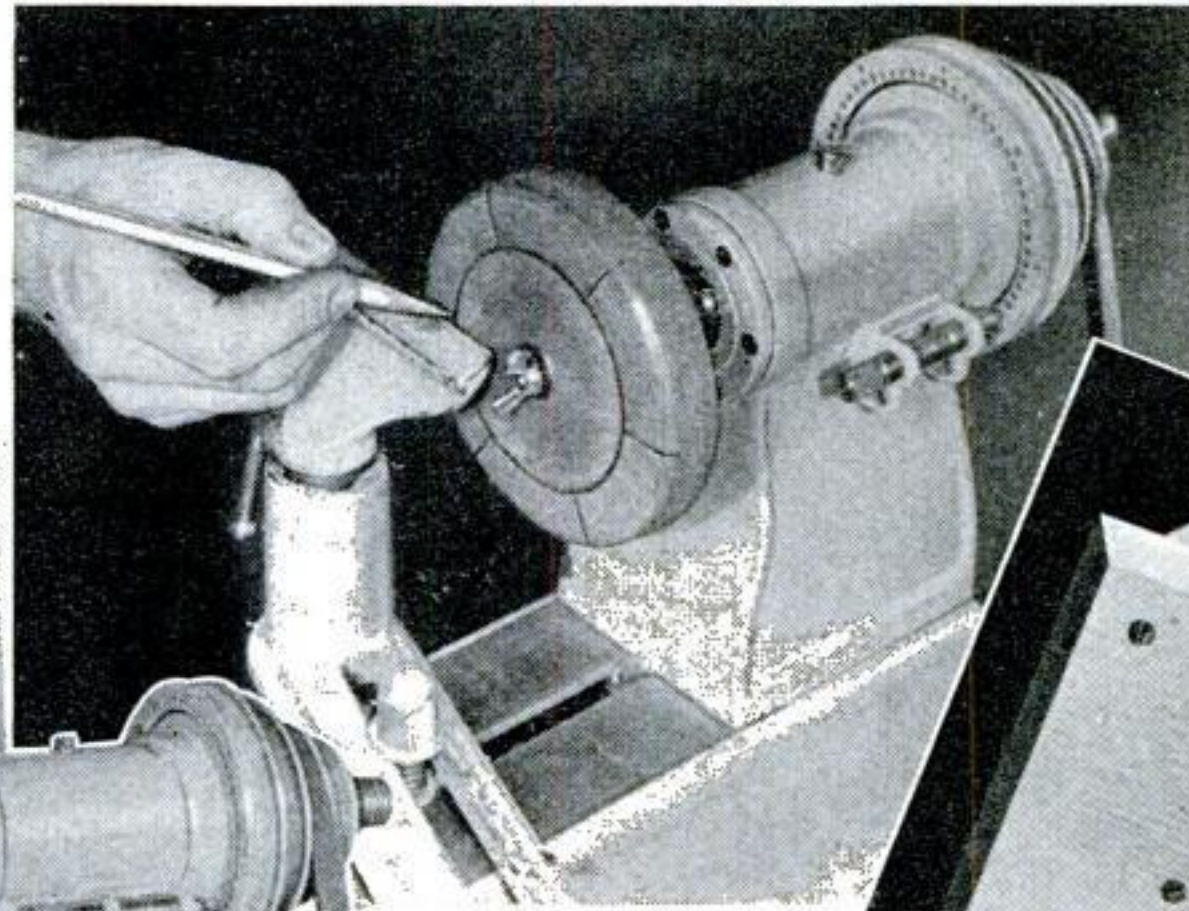
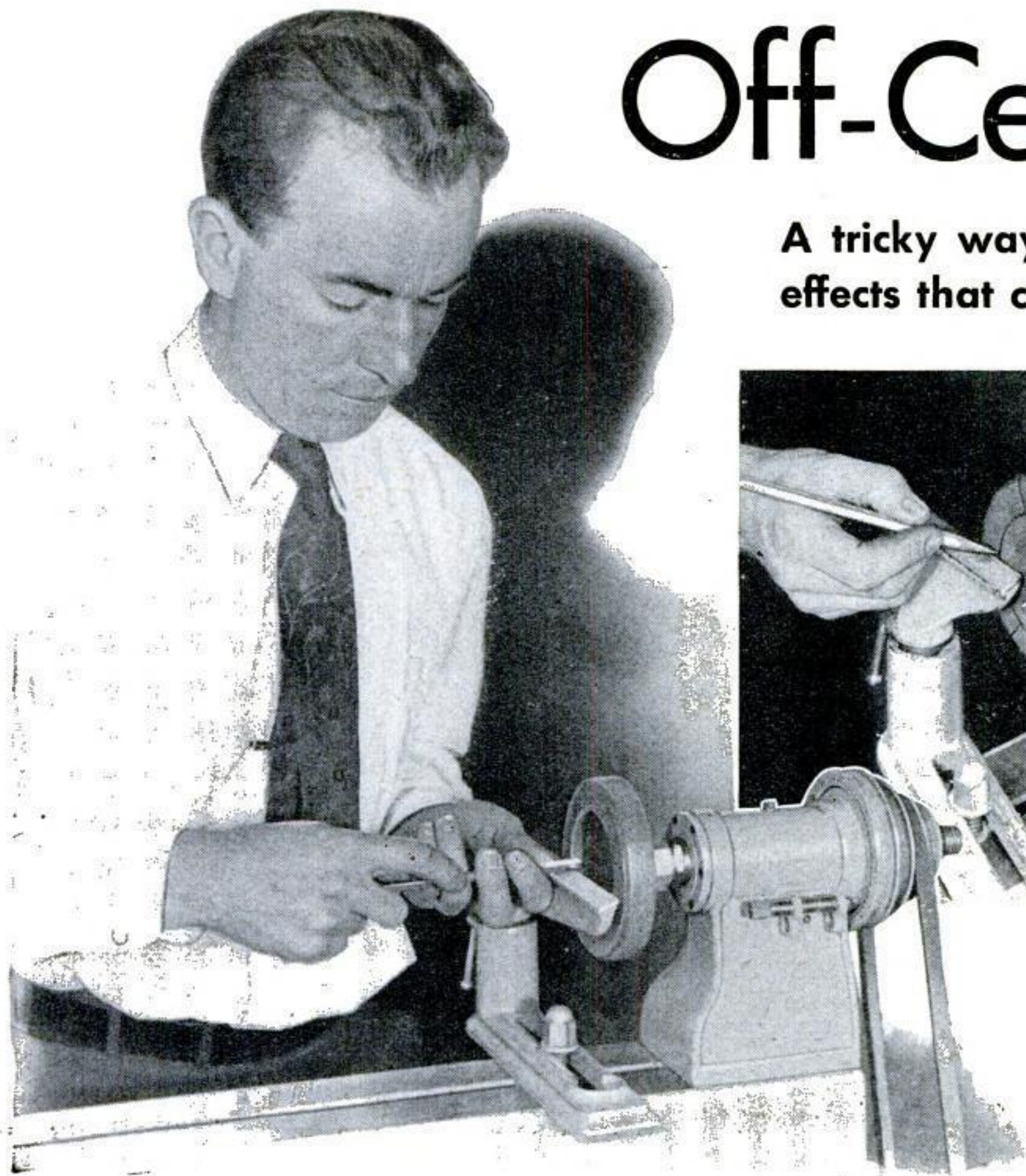
The jig illustrated is one I made years ago and still use every day in my shop. It can be made any convenient size. That shown will serve for tenoning stiles and rails up to 5 in. wide and up to 2½ in. thick.

Note that the underside of the base is grooved to take two cross slides of 3/16 by ¾ by 4½-in. oak and slotted directly over the grooves so that the slides may be adjusted with bolts and wing nuts as required. Running lengthwise along the bottom is a strip of cold-rolled steel to fit the groove in the saw table—in my case 3/16 by ½ in. Countersunk holes are drilled in this for the stove bolts, which then pass through holes in the oak cross slides and through the slots. By loosening the wing nuts, the cold-rolled steel slide can be moved sideways to give any required depth of tenoning cut. Always be certain that the work is securely clamped.—B. P. SEWARD.

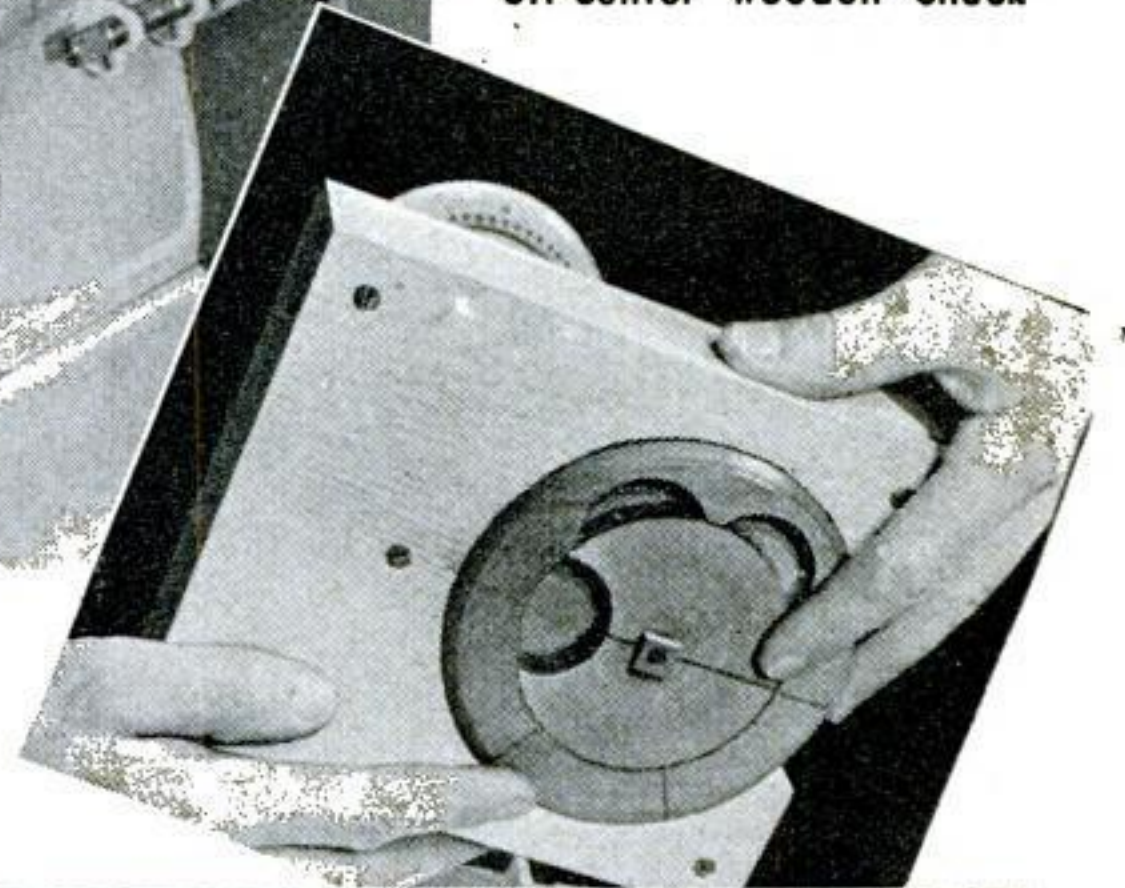


Off-Center Turning

A tricky way to use your lathe for ornamental effects that can be obtained by no other means



A mahogany disk is turned to fit the recess and mounted as at the left. Then the base is divided into six parts with the index head. Below, the off-center wooden chuck



The base for the mahogany candlestick illustrated below is first turned on a faceplate and recessed in the center to whatever depth is desired

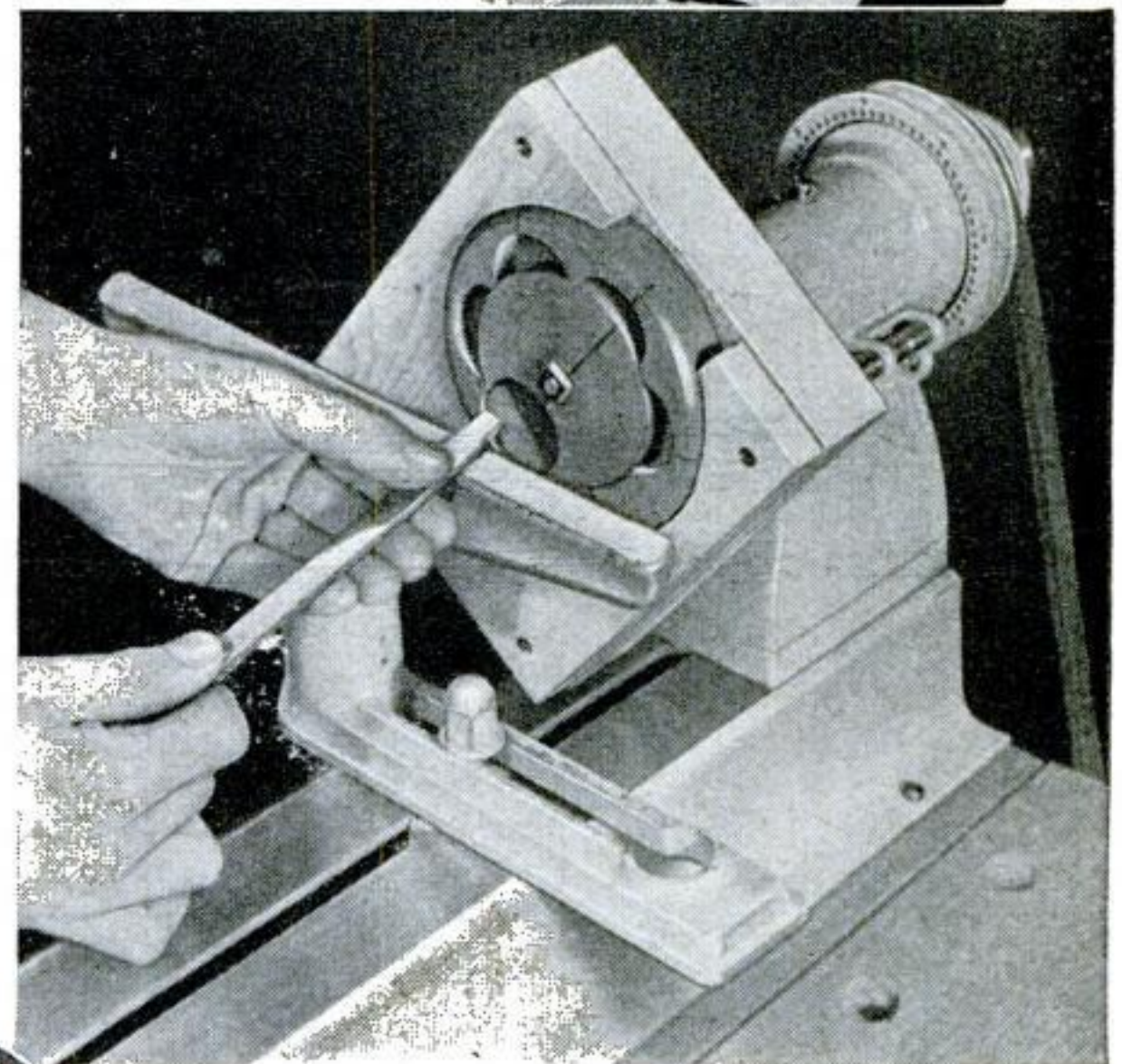
By HOWARD R. HEYDORF

BASES, trays, and many kinds of spindle turnings may be ornamented by what is best described as "off-center turning." It is a tricky but simple method, the secret of which is made clear in the accompanying illustrations of a mahogany candlestick.

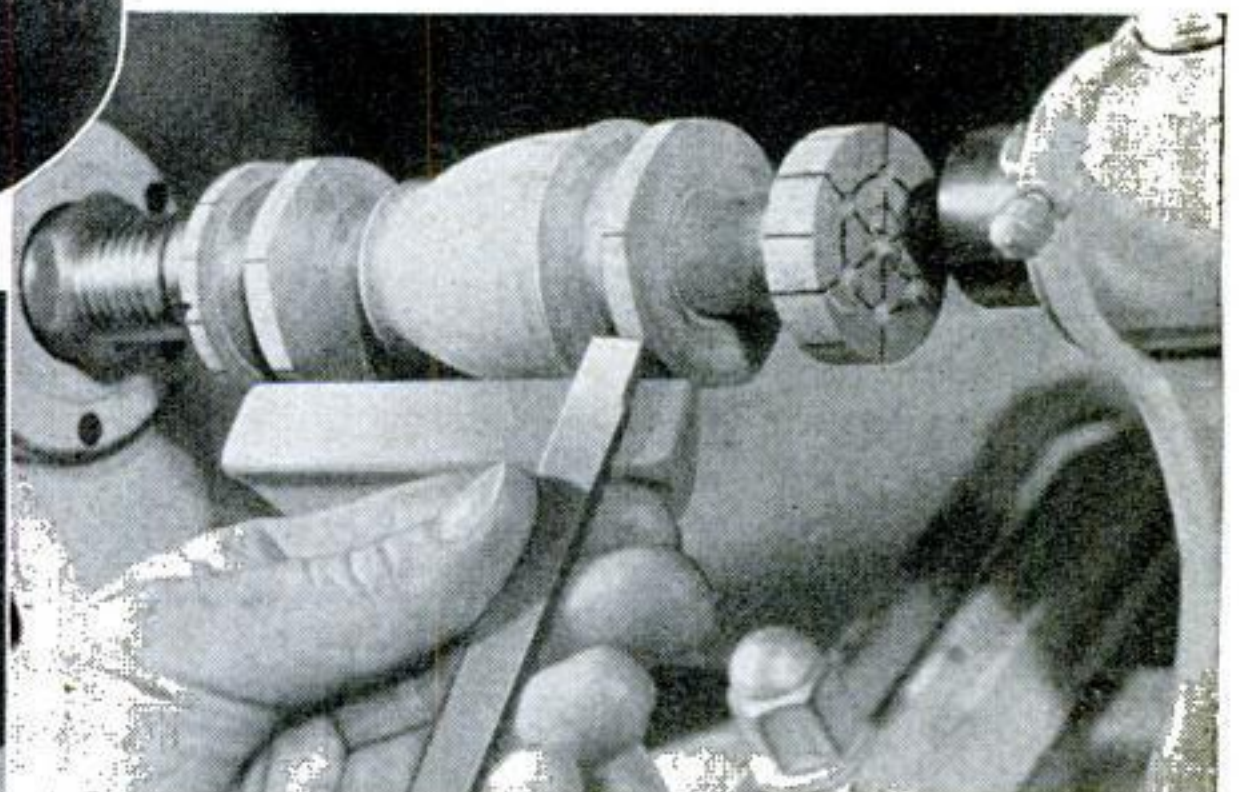
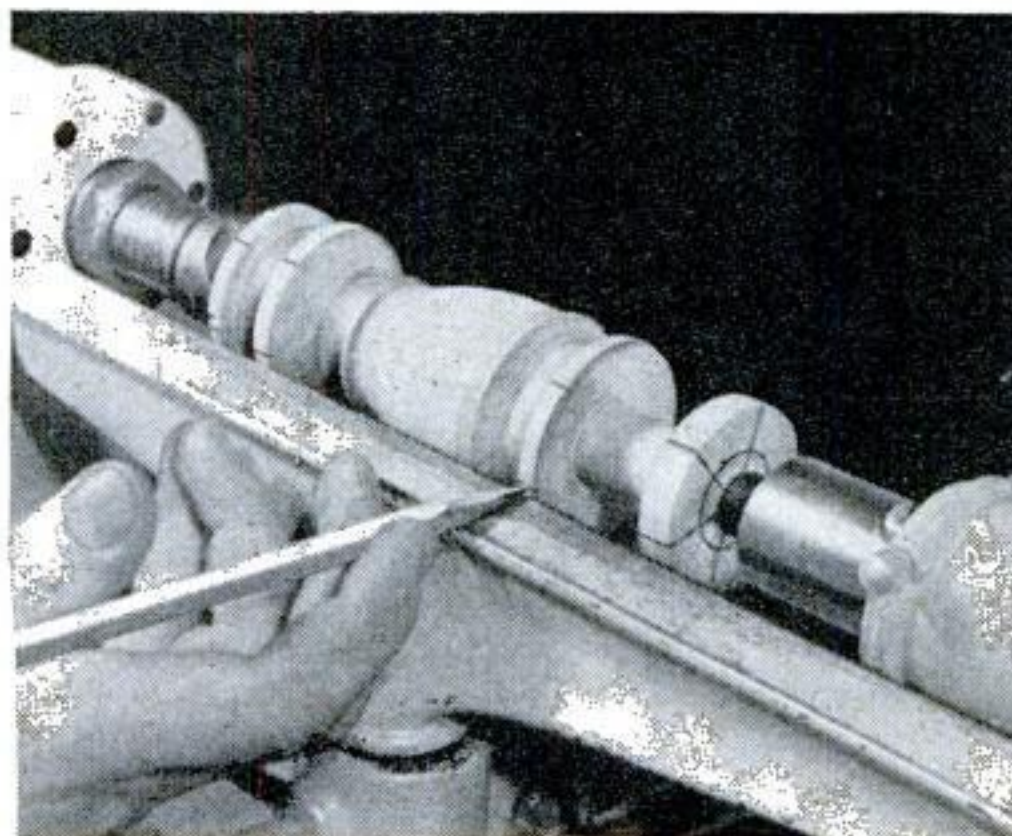
The base was turned and recessed, and a disk of the same wood made to fit. The two were mounted together as shown, and the rim divided into six divisions. A heavy block of wood was then centered on the faceplate, and another thinner piece jigsawed to contain the base and screwed on in a position to hold the base the required distance off center. (When it is not desirable to hold the base and disk in place with a carriage bolt, they may be secured by a strip of wood clamped across their face and held by bolts.) A line is drawn through the center of the base and the center of the lathe for aligning the arcs, which are bored at low speed.

If arcs have to be formed on the outside of a turning, the wooden chuck itself is used as backing block.

The candle socket was first turned in the regular manner, then divided as indicated, and the rims turned off center. The point where each dividing mark intersected the small circle ($\frac{3}{4}$ in. in this case) was used as the center for each arc.

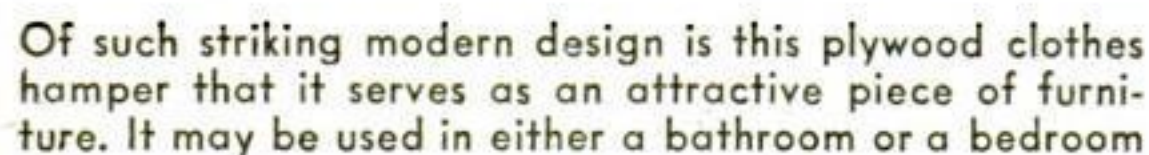


After each hole has been bored, the base is revolved and clamped so another hole may be made. The center disk serves as guide and depth gauge



The candle socket is first turned in the customary way; then a circle is marked on each end and divided to establish the off-set centers for turning the rims. Left, how the turning was marked before the step above. If the whole spindle is to be shaped, which is much harder, draw the divisions all the way along

THREE UNIQUE MODERN PIECES DEVELOPED FROM ONE



In the clothes-hamper design, the opening for the clothes is at the top of the front, leaving the top fixed and available as a shelf for toilet articles. The small rounded shelves at the sides are convenient for holding a variety of articles.

The method of construction may easily be worked out from the drawings and list of materials. When you are certain all parts fit well together, take them apart and assemble with glue. The use of casein glue is advised because of its slow-setting quality, for quite a time may elapse before the assembling can be completely accomplished. As so much end grain is involved in gluing plywood, it is best to apply two coats of glue. Go over all joints before the assembly is started and glue each joint a second time as it is being put into place. Fill all cracks and build up any chipped places with wood composition or a mixture of glue and sawdust before enameling or lacquering.—DONALD A. PRICE.

1. Back, 1 pc. $\frac{1}{2}$ by 31 by $29\frac{3}{8}$ in.
2. Top, 1 pc. $\frac{1}{2}$ by 12 by 31 in.
3. Sides (r. and l.), 2 pc. $\frac{1}{2}$ by $11\frac{11}{16}$ by 29 $\frac{11}{16}$ in.
4. Shelves, 6 pc. $\frac{1}{2}$ by $6\frac{3}{16}$ by $11\frac{11}{16}$ in.
5. Front, 1 pc. $\frac{1}{2}$ by $18\frac{3}{8}$ by $19\frac{1}{16}$ in.
6. Door, 1 pc. $\frac{1}{2}$ by $17\frac{7}{8}$ by 10 in.
7. Bottom, $\frac{1}{2}$ by $11\frac{11}{16}$ by $18\frac{3}{8}$ in.
8. Handle (maple), 1 pc. $\frac{5}{8}$ by $1\frac{1}{4}$ by $2\frac{1}{2}$ in.
9. Door stop (hardwood, not detailed), $\frac{3}{4}$ by $\frac{3}{4}$ by 18 in.
10. Catch block (hardwood, not detailed), $\frac{3}{4}$ by 1 by $2\frac{1}{2}$ in.

NOTE: The material is $\frac{1}{2}$ -in. five-ply fir except where otherwise noted.

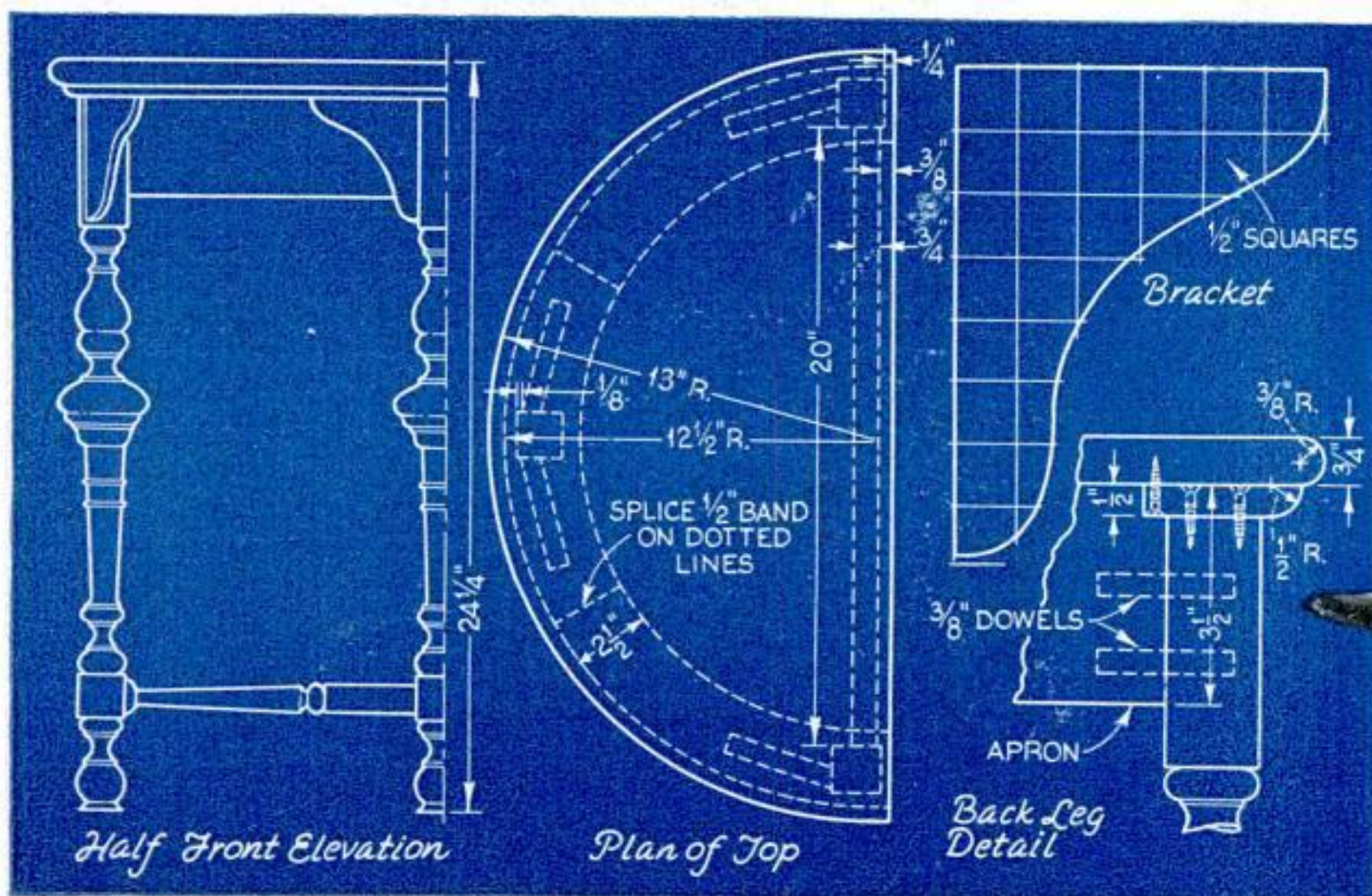
NOTE: The material is 1/2-in. five-ply fir except where otherwise noted.



Working drawings of hamper with parts numbered to correspond with list of materials. Two other designs are shown—a dressing table (with one drape omitted for clearness) and a sewing cabinet

Cabinet, and Dressing Table

BASIC DESIGN...AND OTHER PLANS FOR BUILDING FURNITURE



Assembly views of the end table, which has a semicircular top and three legs. Details of bracket, joint between back rail and legs, and top are also given

Decorative Walnut End Table Has Legs Turned in William-and-Mary Style

PATTERNED after furniture of the William-and-Mary period, this walnut end table gives the amateur cabinet-maker an opportunity to turn three characteristically beautiful table legs. (For hints on making duplicate turnings, see P.S.M., Dec. '37, p. 94.)

The following are needed: 1 pc. 1 by 14 by 36 in.; 3 pc. 2 by 2 by 24 in.; 1 pc. 1 by 4 by 24 in.; 1 pc. 1 by 1 by 30 in., and 1 pc. 1/2 by 4 by 36 in., all walnut; also 3/8-in. dowels, glue, screws, and finishing materials. The cost in the writer's case was slightly more than \$2.

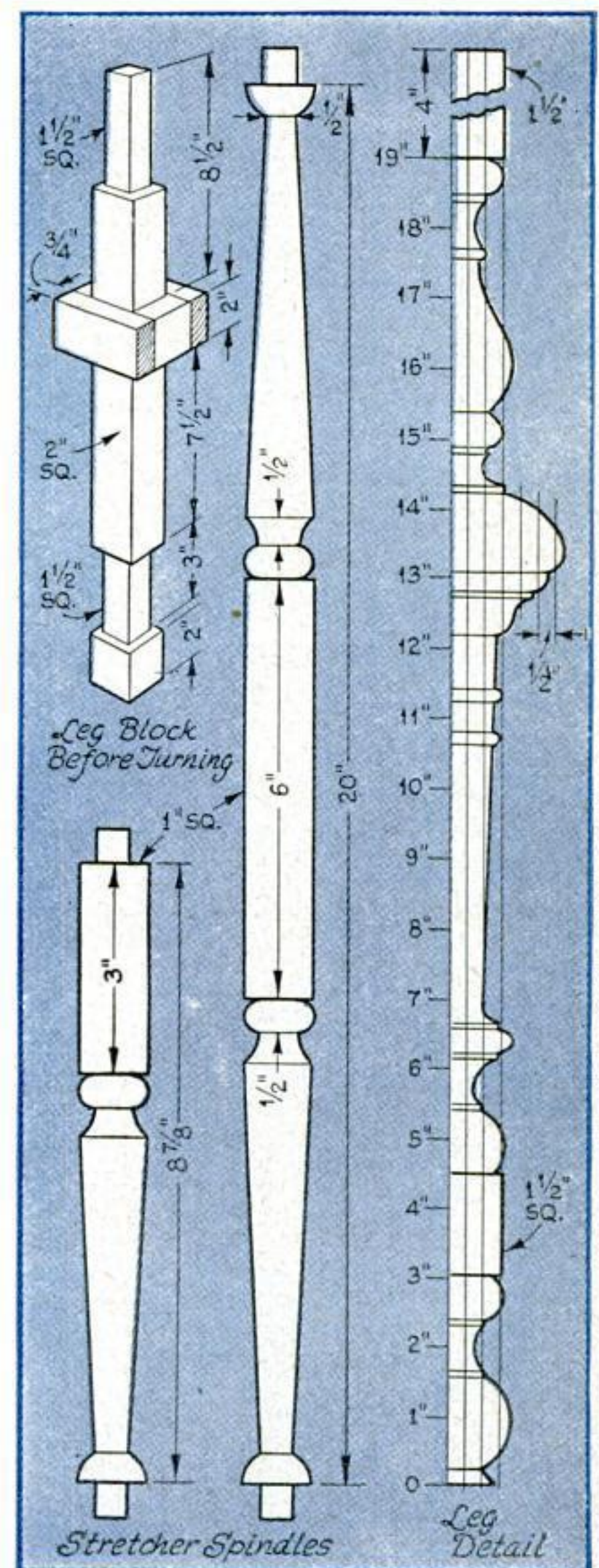
First dress down those parts of the legs at the top and near the bottom which are to remain square. Make them 1 1/2-in. square as shown. Next glue the two 3/4 by 2 by 2-in. blocks to opposite sides; then, after the glue has dried, joint the edges and glue on the other blocks. Center both ends and turn in

the lathe in the usual way. The profile of the leg design used by the writer has been drawn in such a way as to avoid a multiplicity of dimensions. The light lines, which represent 1/2-in. spaces, are a sufficient guide. Turn the stretcher spindles from 1-in. square stock with 1/2-in. dowels at each end.

Cut the top and other pieces to shape, rounding all edges. Waste material from the top furnishes the stock for brackets and leg blocking.

Assemble the table by first doweling together the back legs, apron, and long spindle. Glue the front leg and short spindle in place and screw the 1/2-in. flat curved rail to top of legs. Fasten the brackets by screwing down through the rail. Screw through brackets into legs and fill the holes with walnut plugs.

Sandpaper thoroughly and stain, fill, and varnish.—NEIL NELSON.

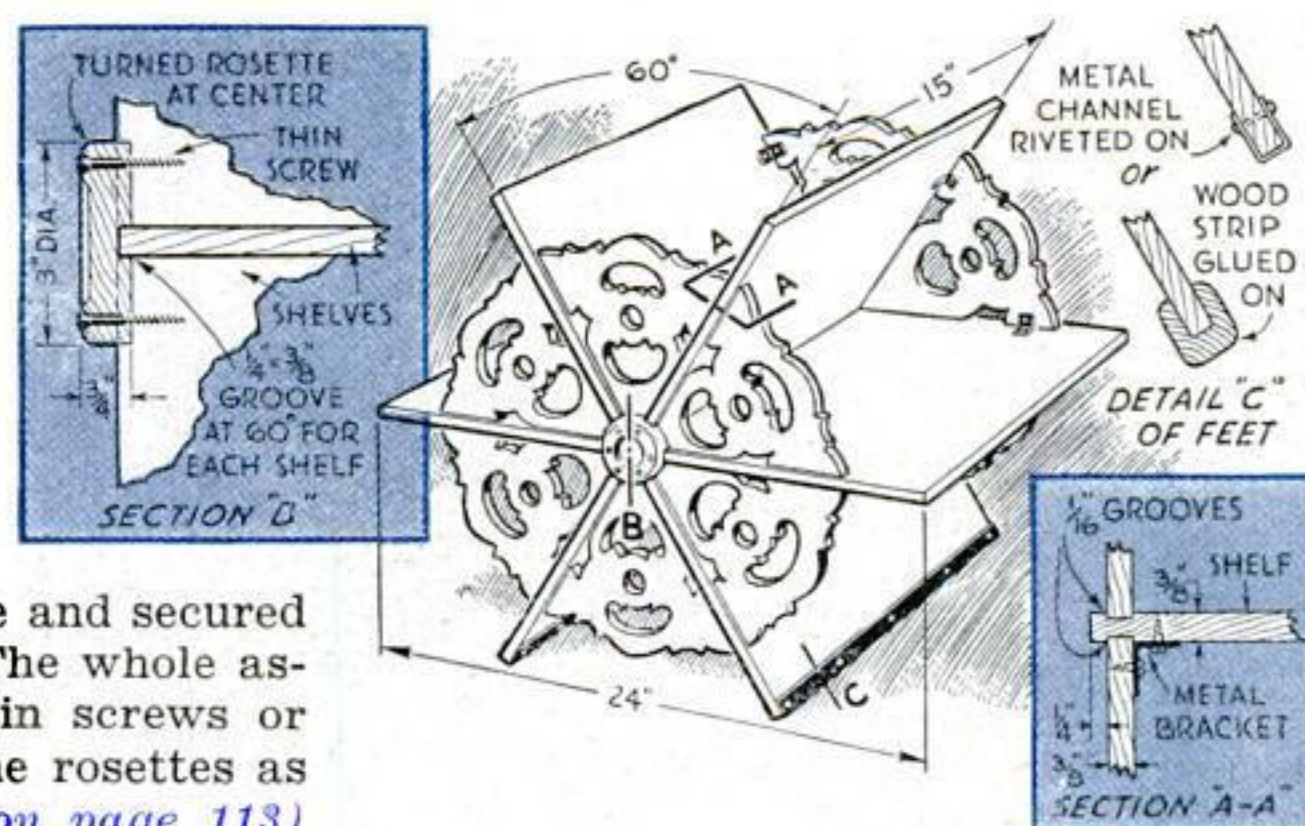


How the leg block is prepared, a half pattern of the leg, and drawings of the two turned spindles used as stretchers

A Magazine Rack of Paddle-Wheel Design

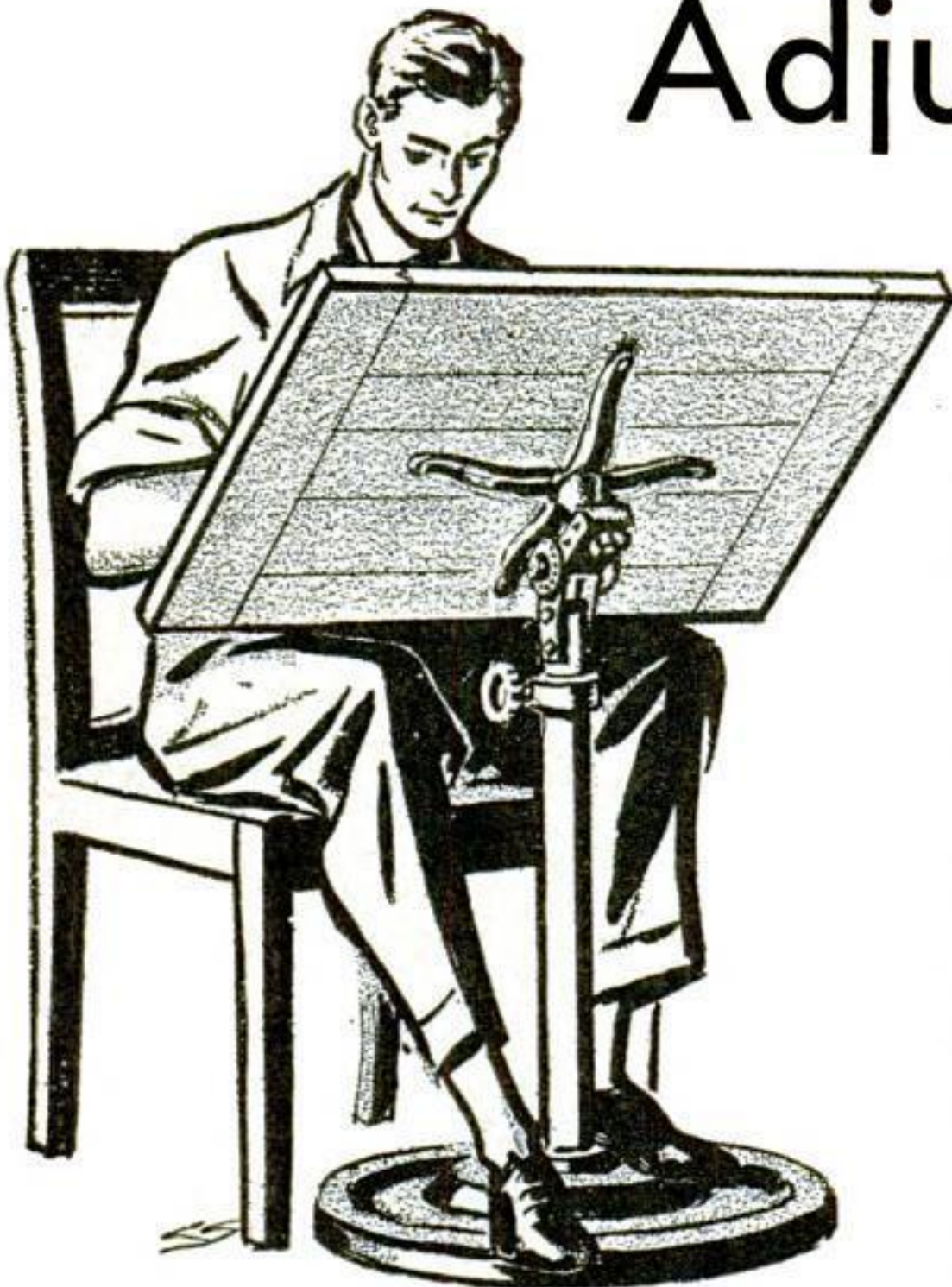
UNLIKE any of the ordinary types of magazine racks, this one consists of six radiating leaves of thin wood held together by scroll-sawed pieces glued in grooves near the end of the leaves.

The two horizontal leaves should be in one piece 15 by 24 in., and the other four are fitted to its center line and secured by two ornamental rosettes. The whole assembly is tied together by thin screws or nails into each leaf through the rosettes as shown at B, and (Continued on page 113)



Adjustable Drawing Stand

FROM OLD AUTO PARTS



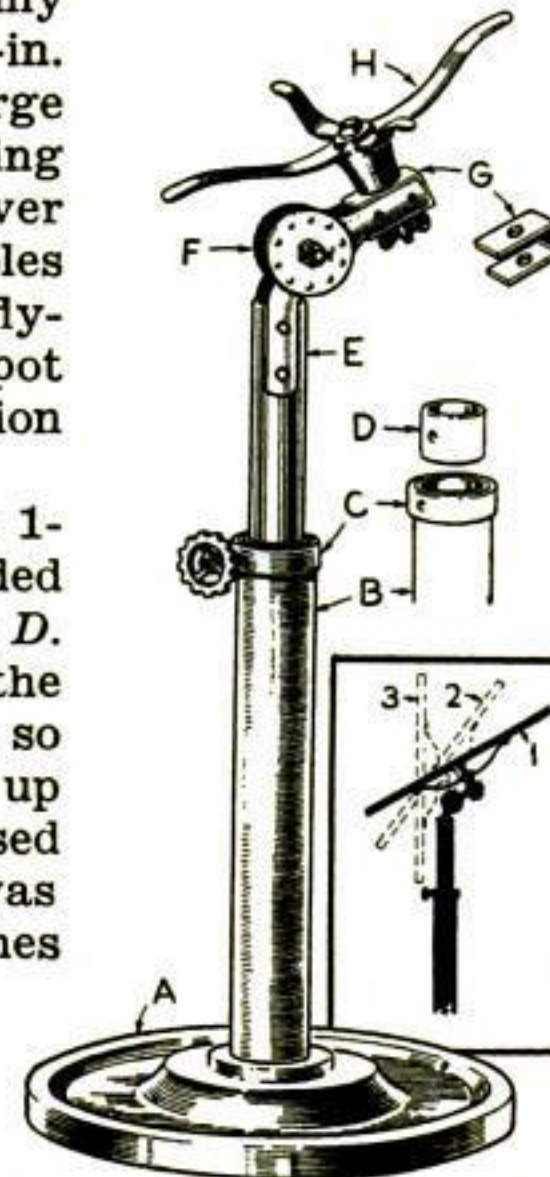
A heavy-duty, adjustable stand made mainly from junked auto parts and a piece of pipe

HIGH-GRADE drawing stands are expensive to buy, but it is possible, by using a little ingenuity, to make a substantial, adjustable, all-metal table from old auto parts and other materials obtained at a junk yard. The construction will depend to some extent upon the available materials. In the example illustrated, long-discarded model-T Ford

parts were used—a flywheel, a drive-shaft housing, two windshield brackets, and a steering wheel. In addition, it was necessary to get a piece of pipe $1\frac{3}{4}$ in. in outside diameter and about 24 in. long, two bushings, bolts, and a few miscellaneous items mentioned later.

All parts were thoroughly cleaned and buffed. A 20-in. length was cut from the large end of the driveshaft housing B. Flywheel A was slipped over this and bolted in place. Holes and indentations in the flywheel were filled with spot putty or plastic composition wood.

Ring C was shaped from 1-in. wide strap iron and welded in place along with bushing D. The inside diameter of the bushing is just large enough so that pipe E can slide freely up and down. The wheel bolt used for height adjustment was taken from an old clothes wringer, the original threads being removed and substituted with the S.A.E. type. The ring C was used mainly to give depth to the threads. It was drilled and tapped for the wheel bolt.



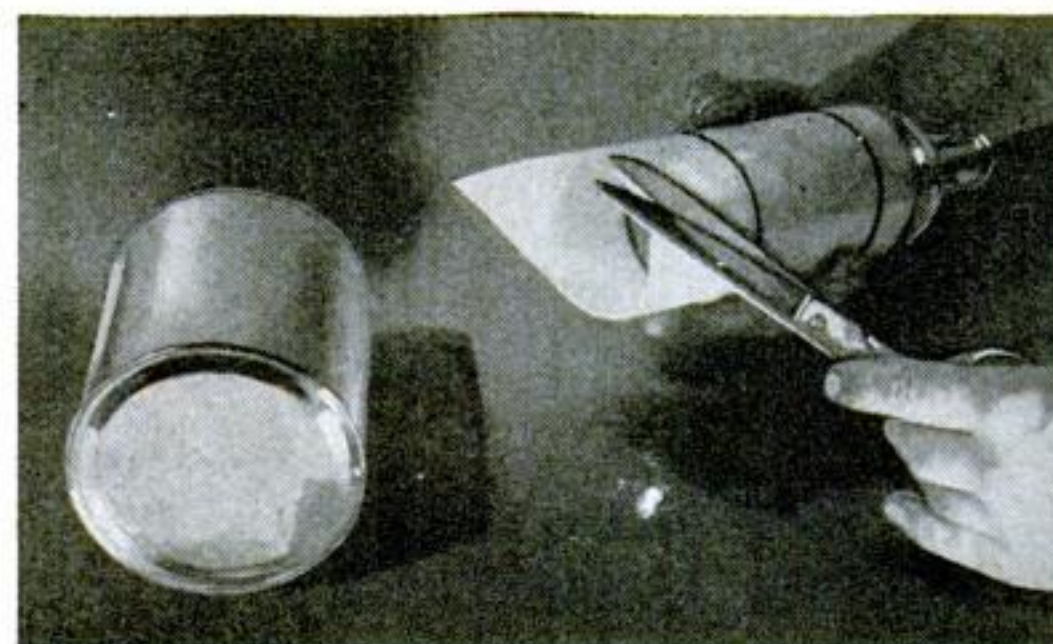
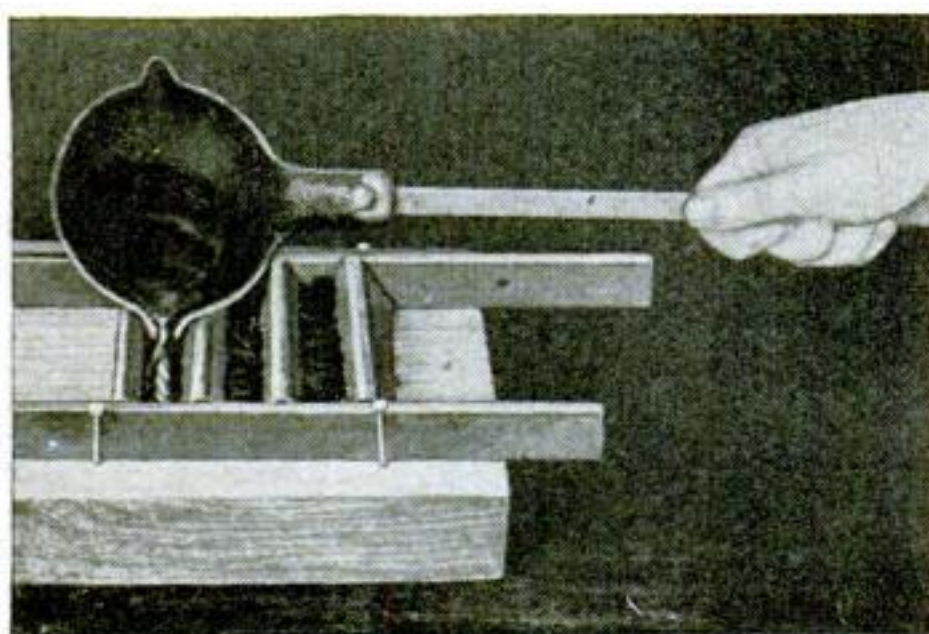
How the stand was built and the three positions in which it automatically tilts

The automatic adjustable windshield brackets were bolted on either side of pipe E and leveled with great care. Then a piece of sheet steel was bent into the shape of G so that it would fit snugly over the extending brackets of F, and welded. A bushing was inserted in the steering-wheel hub H to suit the bolt used, and the hub was fastened with bolt and wing nut as shown. The steering wheel makes a solid bed for the drawing board, which was fastened with the screws obtained in removing the rim from the spider. The spring tension of both brackets and key nuts was then adjusted so that a slight push will move the board automatically into the three most used positions. Position No. 1 is for general drawing, and No. 2 for card writing, blocking in large surfaces, and the like. In position No. 3, the board may be elevated to the correct height, the wing nut loosened, and it actually becomes a free-swinging turn-over board for giving a chalk talk.—ARCHIE HANSEN.

Sticks of Rosin Start Blaze in Fireplace

FOR starting a fire with green or wet wood or when only logs are available, either in the home fireplace or at camp, good use can be made of a fire lighter. This consists of a short length of $\frac{1}{4}$ -in. rope incased in rosin. The rope acts as a wick and is fed by the rosin to produce a roaring blaze, which quickly ignites the wood.

The sticks, or starters, are best made by bending sheet metal to form a series of molds, as shown below. Place a length of rope or heavy string in each mold and pour in molten rosin. The starters will be enhanced in appearance if Xmas tree snow (powdered mica) is mixed with the rosin, or the surface of the rosin (not the molds) is dusted with aluminum powder immediately before pouring.—R. W.

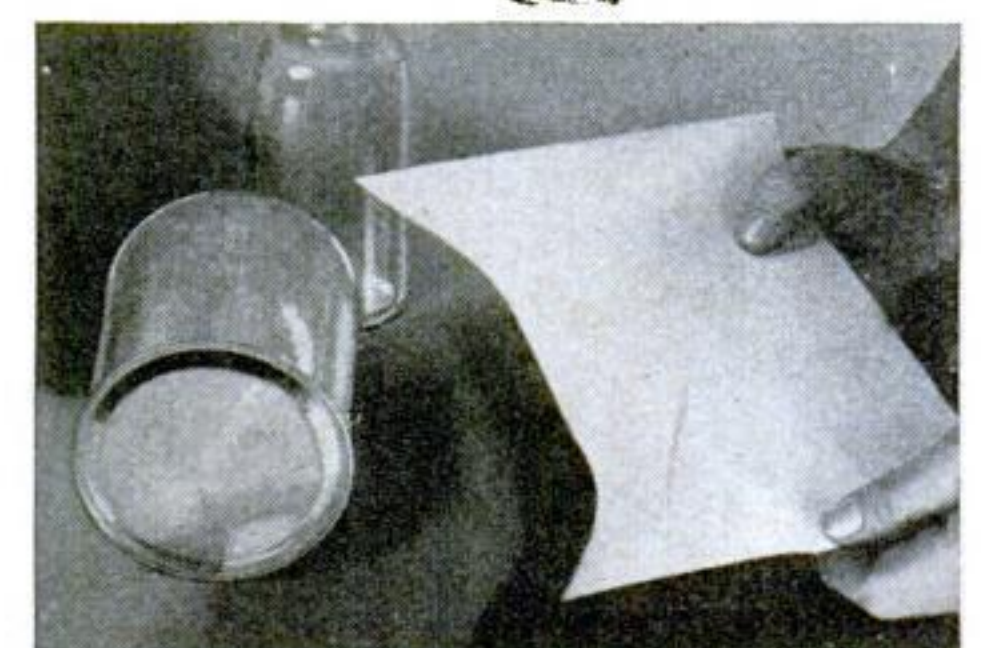


Paper is wrapped around the bottle and trimmed until it fits the can

Cutting Paper Patterns for Sheet-Metal Work

DRRAFTING accurate patterns for sheet-metal work is something the average mechanic hesitates to attempt unless he has a drafting manual at hand with which to refresh his memory of the various principles involved. In many cases, however, a sufficiently accurate pattern may be made simply by bending paper to the required shape and cutting it with a pair of shears.

The illustrations show this method being used to obtain the pattern for a sheet-metal cylinder to be soldered to the side of a tin can. A sheet of paper is wrapped around a bottle of the same diameter as the cylinder is to be and held with cord or rubber bands; then the end is cut to shape by trial and error until it fits the tin can, after which the cylinder is cut open longitudinally to reveal the pattern.—MERLE TERRILL.



The pattern is then obtained by cutting the paper cylinder lengthwise in a straight line

BE YOUR OWN Ski Repairman

How to mend cracks, breaks, and other damage . . . take out twists . . . and make a press for between-season storage

By JULES E. ANDRE



A twist is removed by clamping the ski to a plank with a block under the low portion

EVEN the best of skiers often damages his skis. A rock hidden in the snow is all it takes to cause a mishap. Fortunately, a few general repair methods can be applied in the majority of cases, no matter what their individual peculiarities may be.

Most often the skis are split. Because the wood is thin, glue alone is not sufficient, and strips of sheet metal must be used for reinforcement. Copper about 1/32 in. thick is satisfactory, although it may be thicker or thinner depending upon conditions.

First remove all old wax from the wood. Open the crack as far as possible and work in a thin solution of waterproof casein glue, which serves as a sizing coat and penetrates the pores to make the bond stronger. Then use the glue full strength and clamp or bind until dry. Fasten the metal strip over the crack with screws or rivets. Copper rivets are best for this work, but they should always be countersunk on the running surface.

If the split is close to the side of the ski, the wood should be reinforced with small wooden dowels. In this case, allow the glue to dry twenty-four hours, drill a hole through the split piece into the main part, coat the dowel with glue and force it into place. Cut off the end and smooth with sandpaper.

The same method is used if a small piece is gouged out of the ski. Should the sliver be lost, the easiest way is to smooth the break with a chisel and make a corresponding piece of the same kind of wood. The insert should be a little thicker than the cut so that after the glue is dry, the patch may be sandpapered flush with the surface.

If the wood along the edges is generally worn and battered, the application of metal edges will restore the efficiency of the skis and prolong their life. The way to do this was described in a



Drilling a small dowel hole in the edge of a ski that has been split close to the side



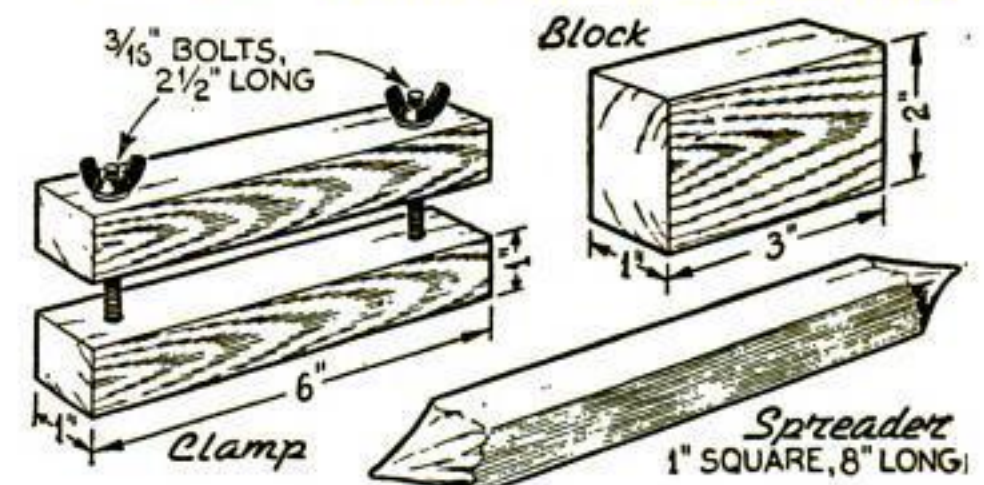
A whittled hardwood dowel is then driven in, although this is not done until the split itself has been glued



Thin copper is next bent to cover the crack and fastened with copper rivets, countersunk on the underside

previously published article (P.S.M., Feb. '38, p. 87).

A broken tip is not unusual, although to graft a new tip is quite difficult. Unless you have an expensive pair of skis, it does not pay. The new tip has to be bought or made, and must correspond in shape and wood to the ski itself. First reduce the thickness of the running surface of the ski on a sander, beginning about 16 in. back from the break, and gradually decreasing the thickness as it approaches the top surface at the break. Taper the new tip the opposite way. Size *(Continued on page 108)*



The essentials of a ski press are two clamps, a block, and a spreader. Right, tightening the top clamp. The spreader is then added to brace the tips apart

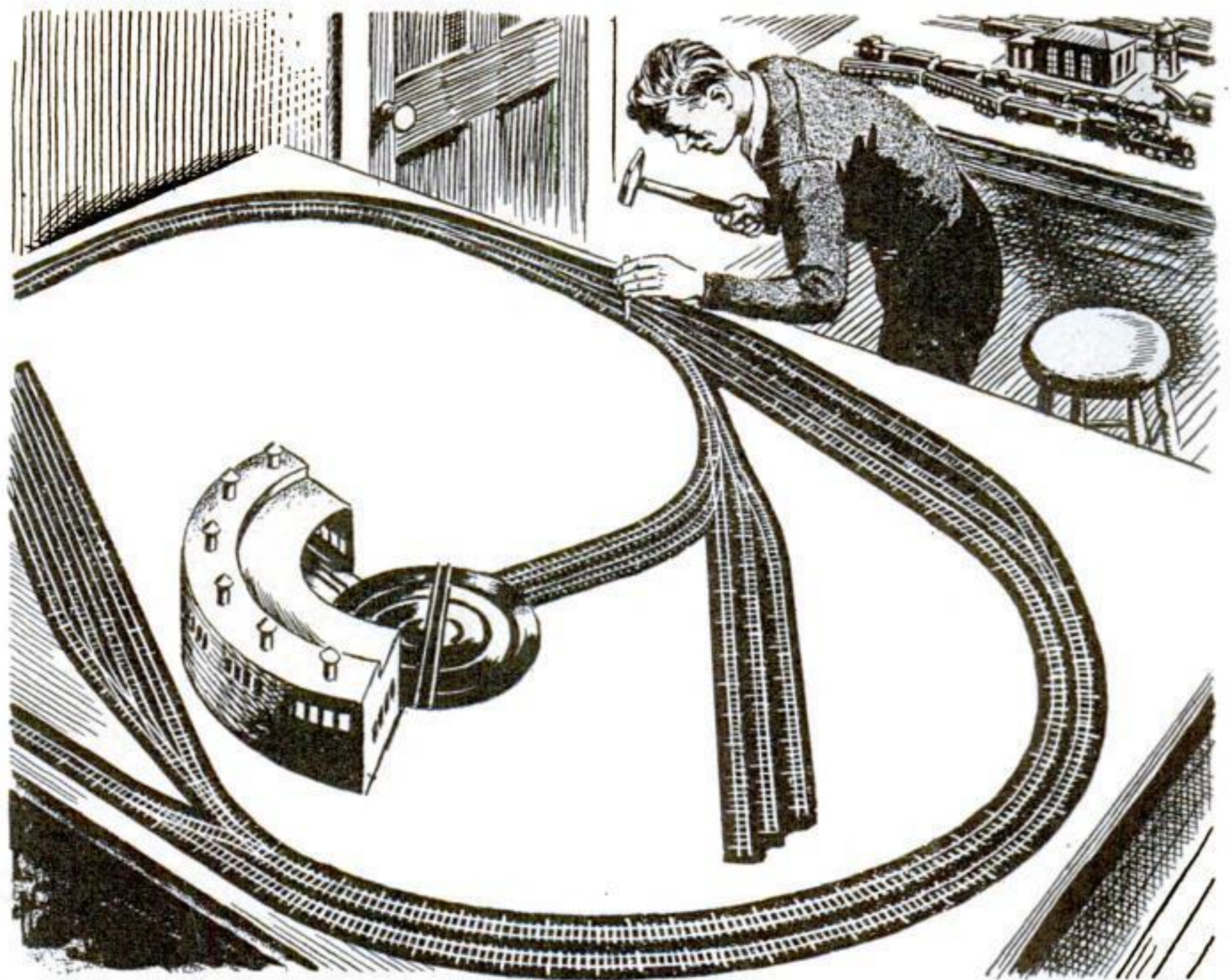


When the handle of a ski pole splits along one side only, it may be bound at intervals with friction tape. If a pole breaks, however, it cannot be fixed very well

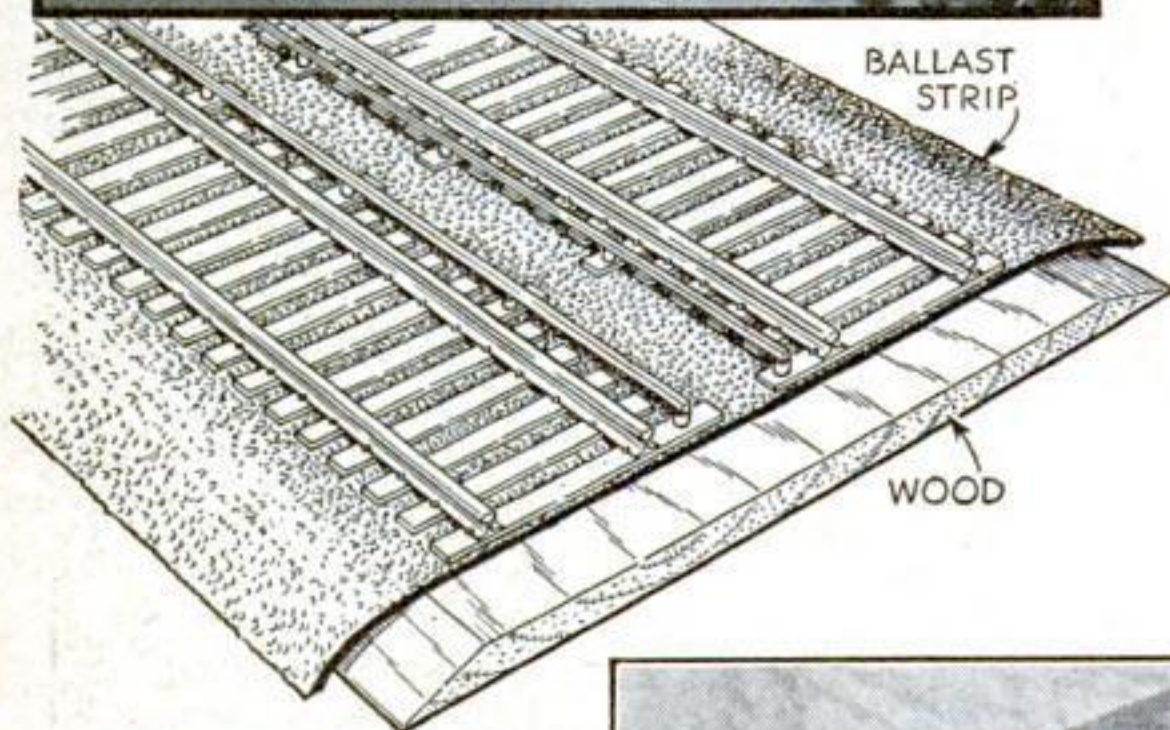
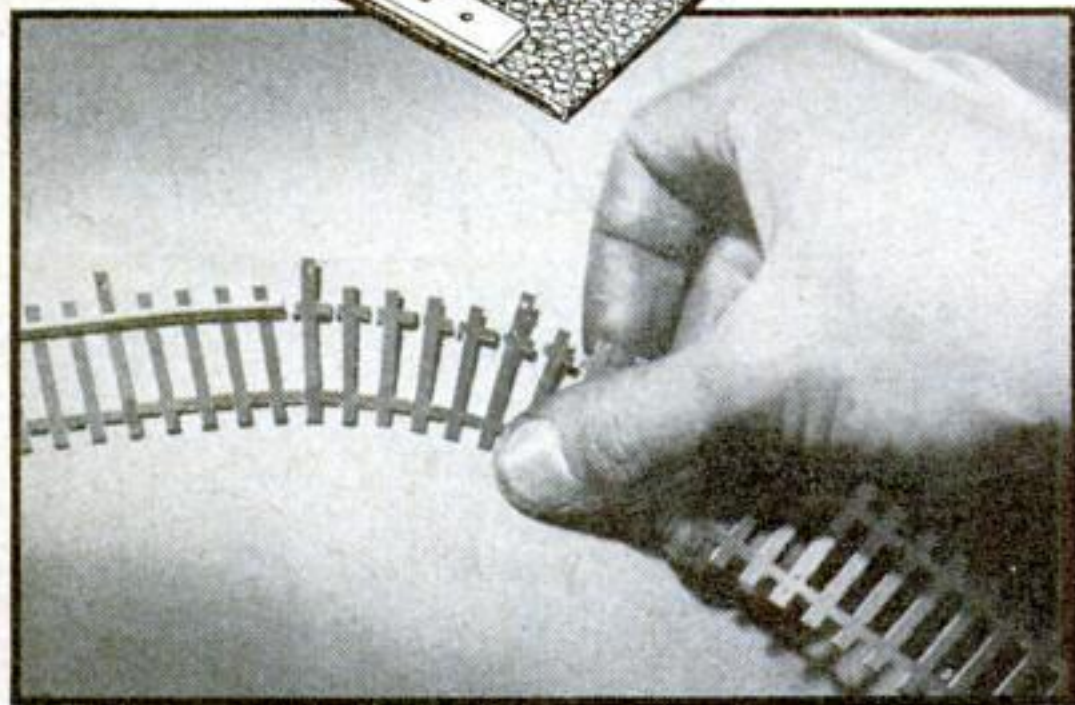
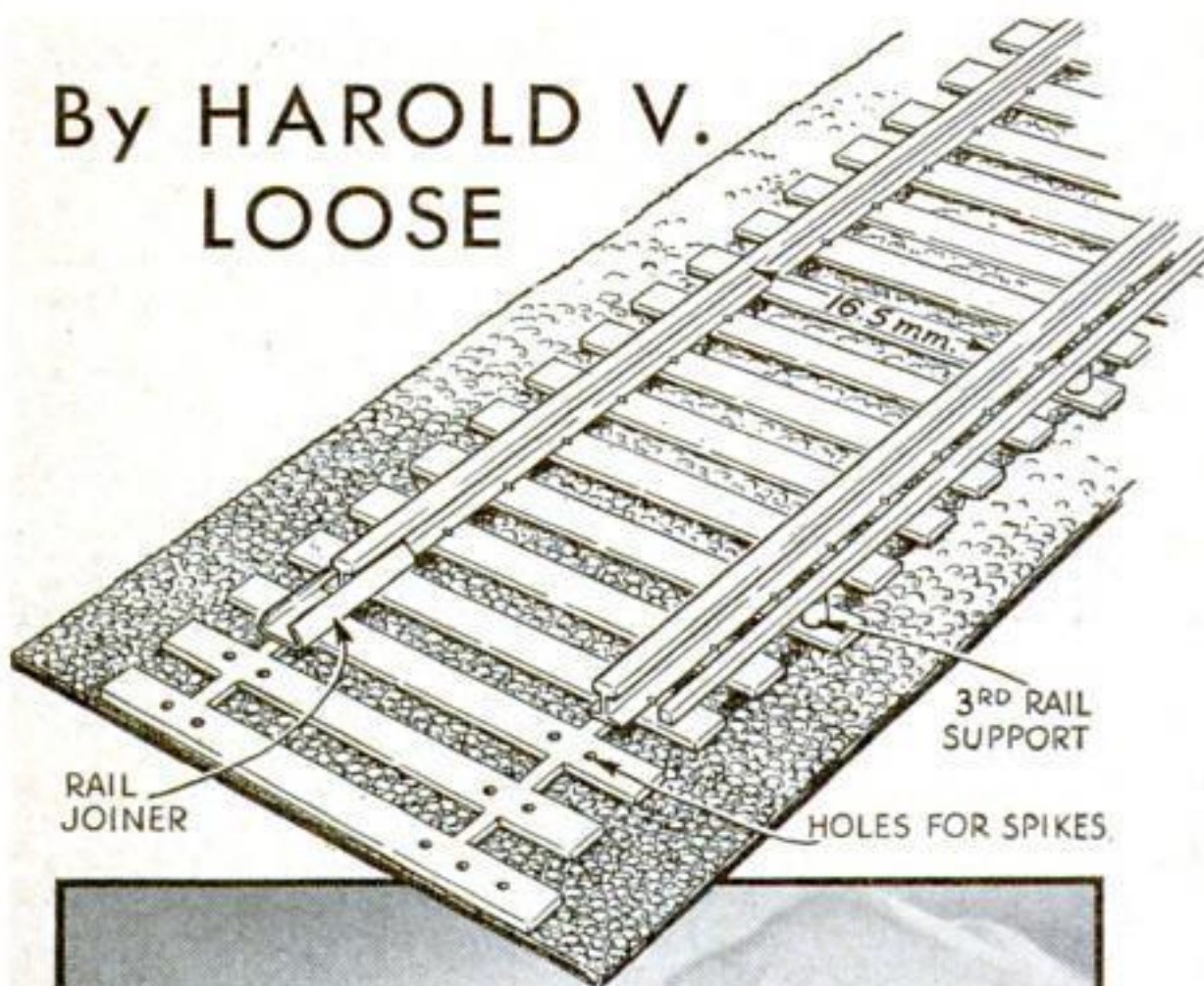
Laying TRACK

FOR AN HO-Gauge Model Railroad

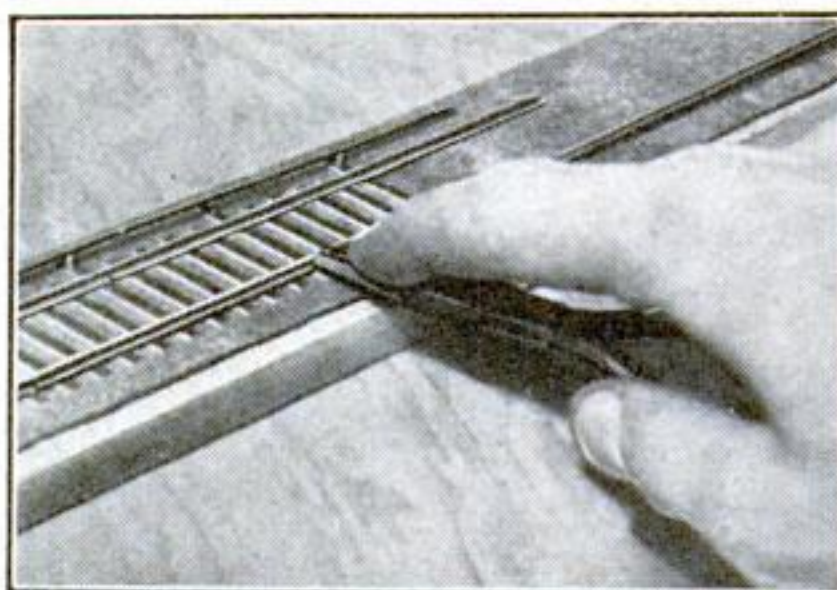
By HAROLD V.
LOOSE



A realistic HO-gauge layout is comparatively easy to build because the ties come in long cardboard strips, all punched out, as at left



How track is laid and method of bending tie strips. Double tracks are often raised slightly



Left, a standard commercial track gauge. Above, spikes are pressed in with pliers and later driven home. Right, the electrical bond

MUCH of the satisfaction that comes from building railroad models is due to the fact that they are practical working replicas. Model ships and airplanes, even when they sail or fly, cannot be controlled once the operator has launched them. A miniature locomotive, on the other hand, can be started, stopped, and reversed; switched from one track to another, and coupled to cars, just as if a tiny engineer were seated in the cab.

To derive this satisfaction from an HO-gauge locomotive such as that described in recent articles (P.S.M., Nov. '37, p. 89, Dec. '37, p. 82, and Jan. '38, p. 86), you must have a good track layout with properly laid rails.

Laying miniature track used to be considered a tedious task, but simplified methods and materials recently introduced have changed that. Rails are hard-drawn brass, correctly shaped, and can be bent easily to any required curve. Instead of using individual wooden ties, HO-gaugers utilize strips of black cardboard punched out ladder fashion. The "rungs" of the ladder represent the crossties, while the "uprights" are connecting bits of cardboard so placed that they will be directly under-

neath the rails and invisible when the track is finished. Holes are punched in the tie strips at proper intervals to receive the spikes, which have offset heads.

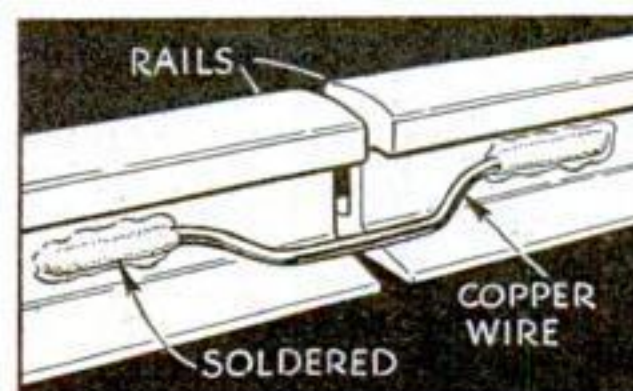
Power supply on most model layouts is by means of a third rail, laid to one side of the track. This is made from square brass rod soldered to special supports.

To imitate the ballast used under the ties of real railroads, many model railroaders use slate-surfaced roofing paper. This is good for larger gauges, but a little coarse for HO. You can buy special material, or use lengths of strip sandpaper of the kind intended for belt sanding machines. Spray it with gray paint to give it the proper color.

The writer prefers a cheaper and more easily available material. This is smooth, tarred roofing paper (not the rough, slate-surfaced kind), which comes covered with a fine layer of mica.

Cut a strip of the ballast material, lay it in place, and hold it down with one or two brads. Then add the ready-made tie strip. This can be held in place with a few drops of model-airplane cement. Place one rail in its proper position, and spike it in place. You can hammer the spikes down if you like, but it is easier to grasp them with a pair of round-nosed pliers as shown and press them through the ballast into the wood beneath. After the track is laid, they may be tightened down by striking them with a hammer and nail set.

Lay one rail, getting it straight and true; then start on the opposite rail. To get this just the right distance from the first, a track gauge is used. This is an inexpensive device that has three grooves into which the tops of the rails fit. Two of the grooves are slipped over the rail already laid, and the third one guides the second rail so it is exactly (Continued on page 111)

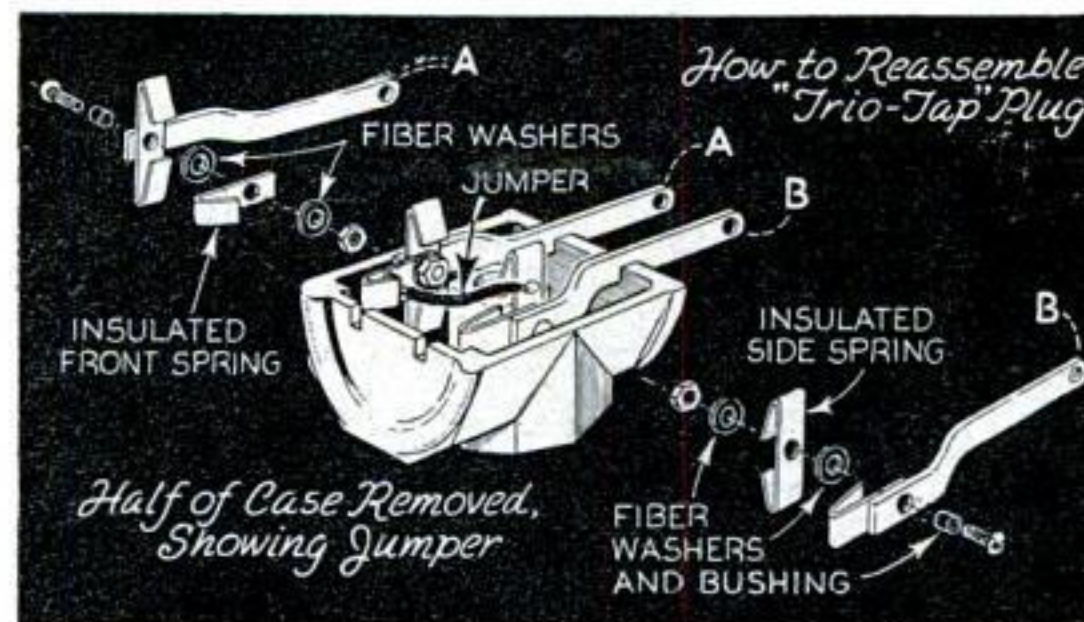


Compact Unit Saves Time in Testing Circuits

NO ONE who has to test house-lighting and appliance circuits can do without a test lamp. He usually has a socket and various lamps and plugs, which are rewired in haphazard fashion to suit the work at hand. Such was the case with the writer until this neat, compact unit was made up. It has saved considerable time in the shop and on the job.

The main unit is made by reassembling a so-called "trio tap." In drilling out the rivets that hold the receptacle springs to the plug prongs, the holes are made large enough to admit a fiber bushing around the small screw used to reassemble the parts. The front spring of A is insulated from the rest, as are the side springs of B. The connection between these two insulated springs, as in the sketch with half the casing removed, completes a unit in which the side receptacles are in parallel with each other and in series with the front. The only additional equipment needed is a plug-in adapter with screw-in socket, a plug base, plug fuse, and test prods leading from a plug.

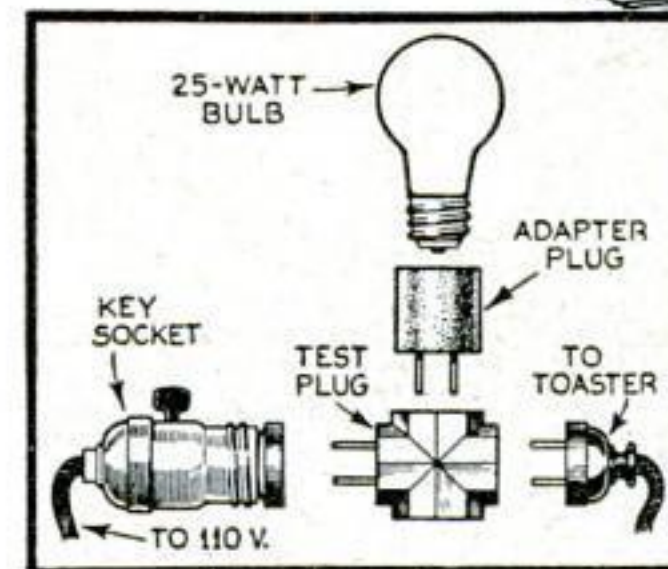
A list of all applications would take considerable space, so only a few will be mentioned and the remainder left to the ingenuity of the reader. A continuity tester is had by putting the adapter with a lamp into the front receptacle and the test prods in the side, or vice



A three-way plug adapted for test purposes. The side receptacles are in parallel with each other, but in series with the front one

versa, with the whole plugged into the 110-volt service. To use the lamp in series with the line as a current-limiting device, when working on a shorted appliance or radio, plug the appliance or radio in the front, and the lamp in the side. When the short is remedied, shunt the lamp by joining the prods on the other side or replace the lamp with a fuse.

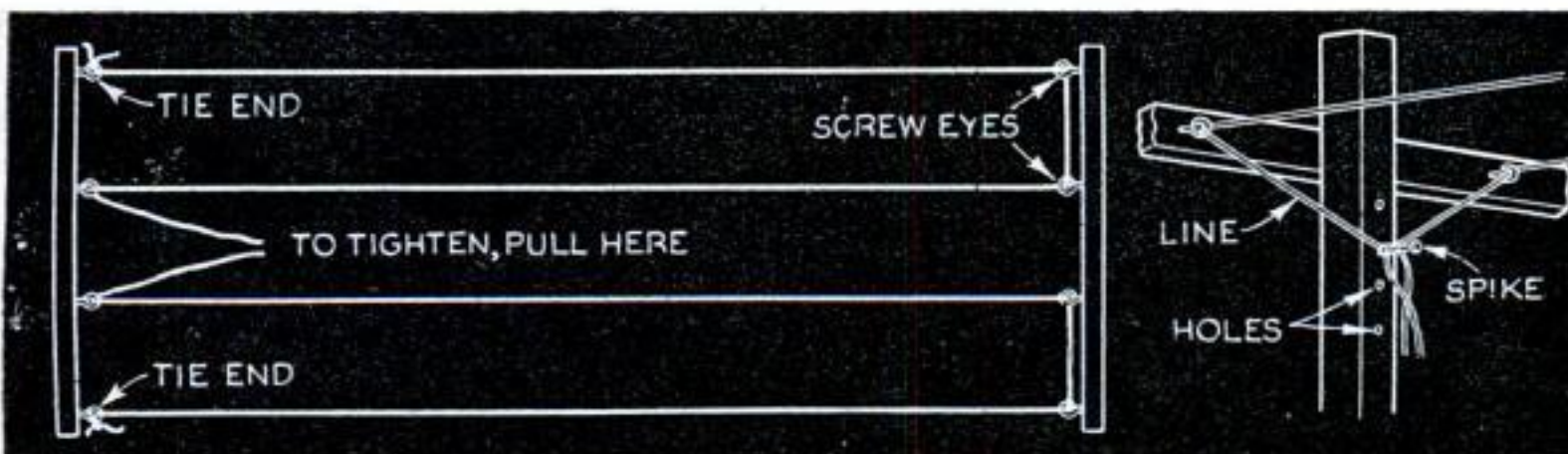
Disconnected from the 110-volt supply, with the lamp and prods in the sides, it can be used for checking circuits other than those with standard plug connections. When fused 110-volt flexible leads are needed, plug in the



How the tester may be used to place a lamp in series with a short-circuited appliance to limit the flow of the current

adapter with a fuse on one side and the leads on the front.

When the writer does low-voltage testing, as on doorbells and auto systems, he uses a low-voltage lamp and dry cell.—W. B. SANFORD.



An Easily Tightened Clothesline

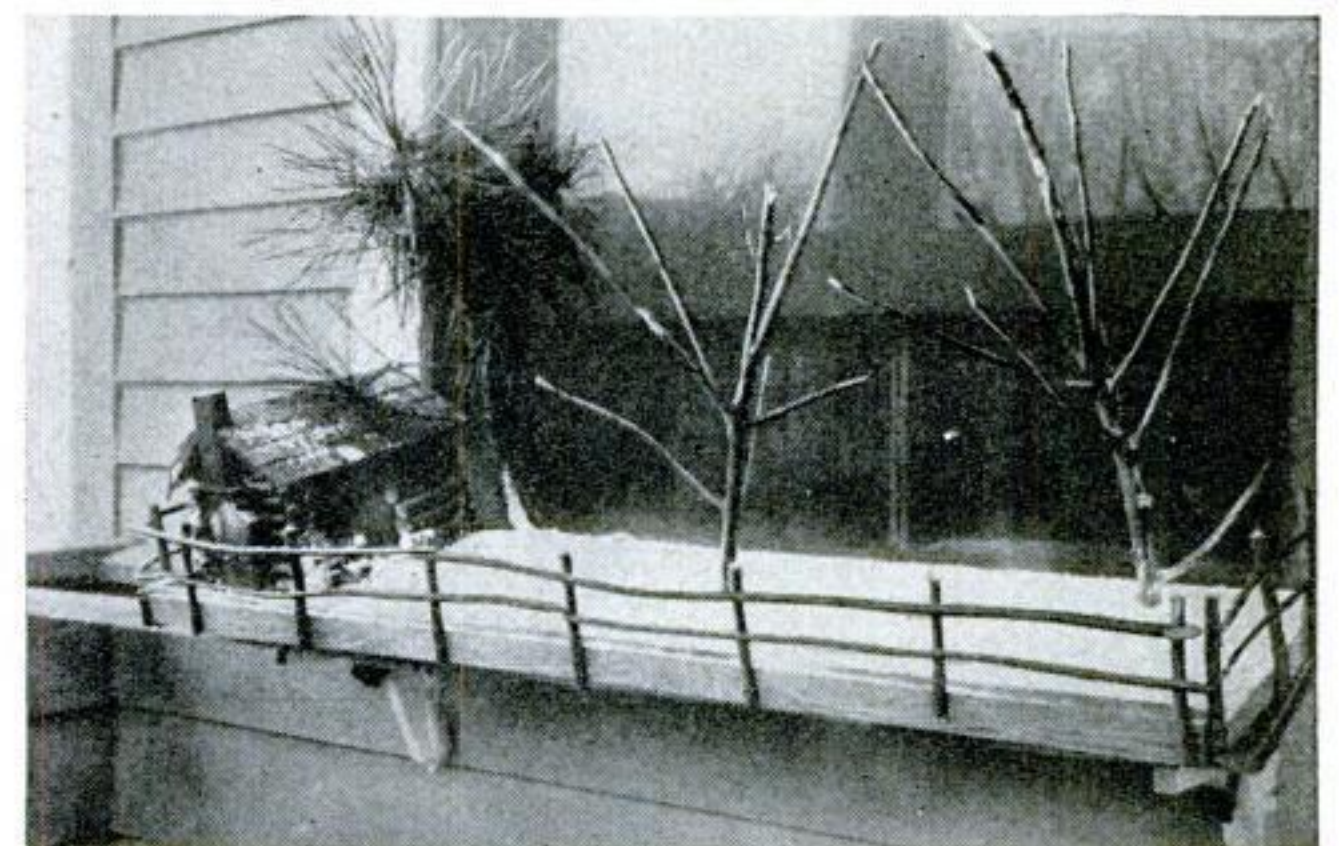
BY ARRANGING a four-line clothesline as shown above, the whole can be tightened on washday merely by pulling down the section between the two center screw eyes at one end. The loop is then held by pushing a 60-penny spike into a hole in the

post. To allow for adjustment, there is a series of holes in the post, 6 in. apart. They are of a size to allow the spike to be slipped snugly into them. The line will last longer if it is loosened after the clothes have been taken down.—W. M.

Food for Birds Set Out on Scenic Window Tray

FEEDING the birds when the ground is covered with snow and ice is a duty that no one should overlook. The photograph below shows a feeding tray that is merely a slightly sloping, 12-in. wide wooden shelf secured to an outside window sill by means of a couple of brackets. The novel part of the tray consists in the way it is landscaped with a miniature log house and trees.

The house is 8 by 11 in. and 9 in. high. The walls are constructed of straight maple sticks $\frac{3}{4}$ in. in diameter, with the bark left on. The roof is of thin pine boards. These are covered with shingles made of cardboard strips, slotted to represent real shingles and given a couple of coats of dark gray outside paint. Trees are small branches set in holes in the shelf, while the rail fence is made of still smaller twigs.—PAUL HADLEY.



A bird-feeding tray decorated with a miniature log cabin and trees. As they feed, the birds can be seen through the window

IT DOESN'T COST
MUCH TO BUILD A

Game Room

By H I SIBLEY

A 12 by 16-ft. Playroom for \$56.61

Estimated cost of finishing a 12 by 16-ft. basement room 8 ft. high (see Fig. 2) in Pasadena, Calif., is about 30 cents a square foot of floor space (not including painting, wiring, built-in equipment, fireplace, or improvements to original stairway). Here are the figures, which would be lower in some sections of the country.

640 sq. ft. of wall board or 1/4-in. plywood for panels at 4 1/2¢	\$28.80
(1/8-in. hard board would cost \$41.60)	
56 lin. ft. 2 by 4-in. sills at 2 3/4¢	1.54
288 lin. ft. 2 by 2-in. studs at 1 3/4¢	5.04
180 lin. ft. 2 by 2-in. floor joists at 1 3/4¢	3.15
576 lin. ft. 3/4 (net) by 4-in. tongue-and-groove No. 3 pine flooring	13.40
192 sq. ft. tar paper	.80
128 lin. ft. 1/4 by 1-in. pine or redwood battens at 1 1/4¢	1.60
112 lin. ft. 3/4-in. quarter-round molding at 1 1/2¢	1.68
24 lin. ft. 3/4 by 4-in. pine window trim at 2 1/2¢	.60
	\$56.61

NOTE: In Fig. 11, baseboard and cornice are shown, but only molding is figured here. If floor is painted, substitute \$2.19 (paint and zinc sulphate cleaner) for tar paper, floor joists, and flooring, a reduction of \$15.16.

WITH a good cleaning and the addition of modern decorative building materials, your basement can quickly be transformed into an attractive recreation room or den. The simplest and least expensive treatment is to clean the floor, apply cold-water paint to the walls and joists, lay a rug or an old carpet, put up a few shelves, and bring down some of the discarded furniture from upstairs. By making an expenditure of \$50 or more, however, a really inviting room

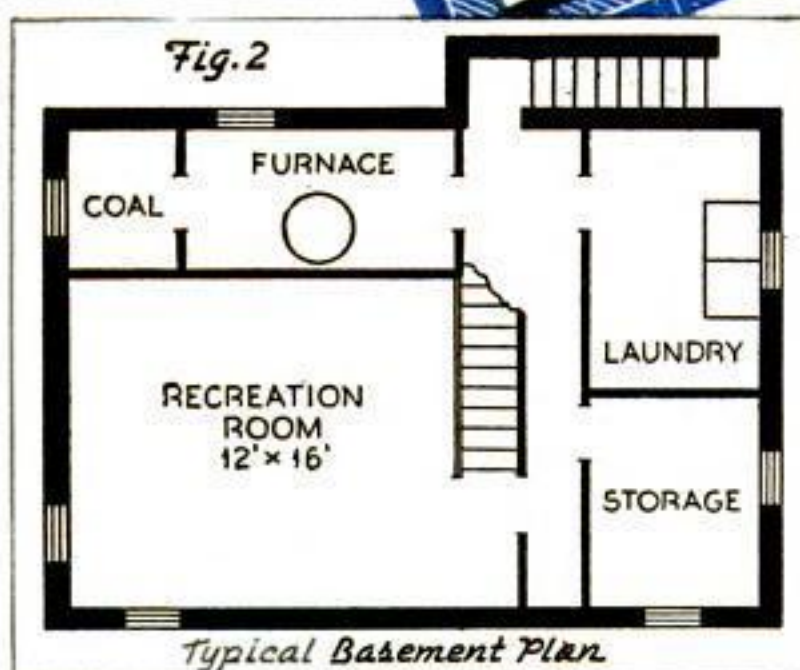
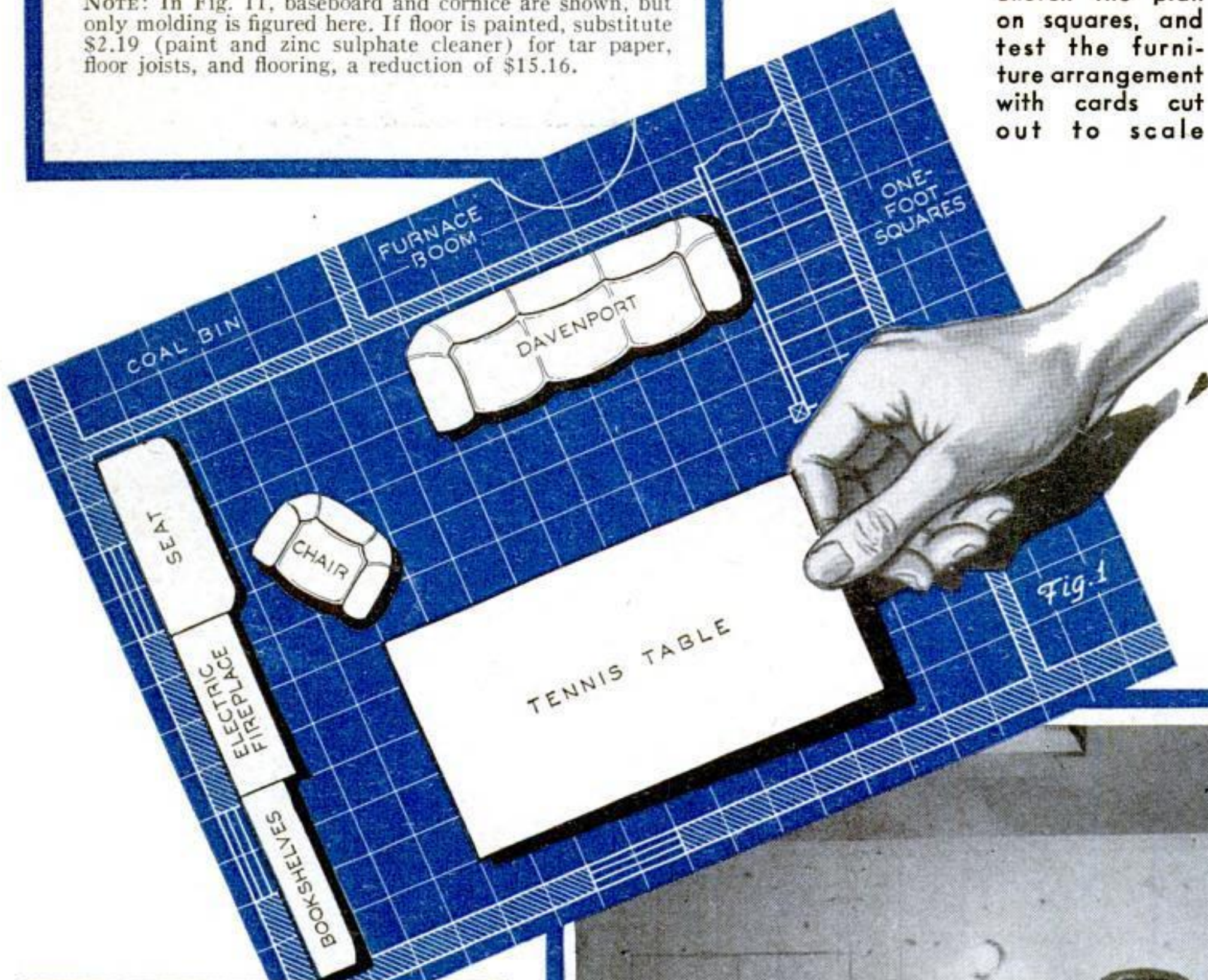
for your recreation can be constructed.

In the case of a 12 by 16-ft. basement room 8 ft. high, for which a tabulation of costs is given, the final figure for installing a wooden floor, and walls and ceiling of wall board or plywood is \$56.61. This does not include painting, wiring, built-in equipment, fireplace, or changes to the stairway. The cost for each square foot of floor space is about 30 cents, but this figure (Pacific Coast) may be even lower in many sections of the country. A further reduction—in this case \$15.16—can be made by painting the concrete floor instead of using joists and flooring.

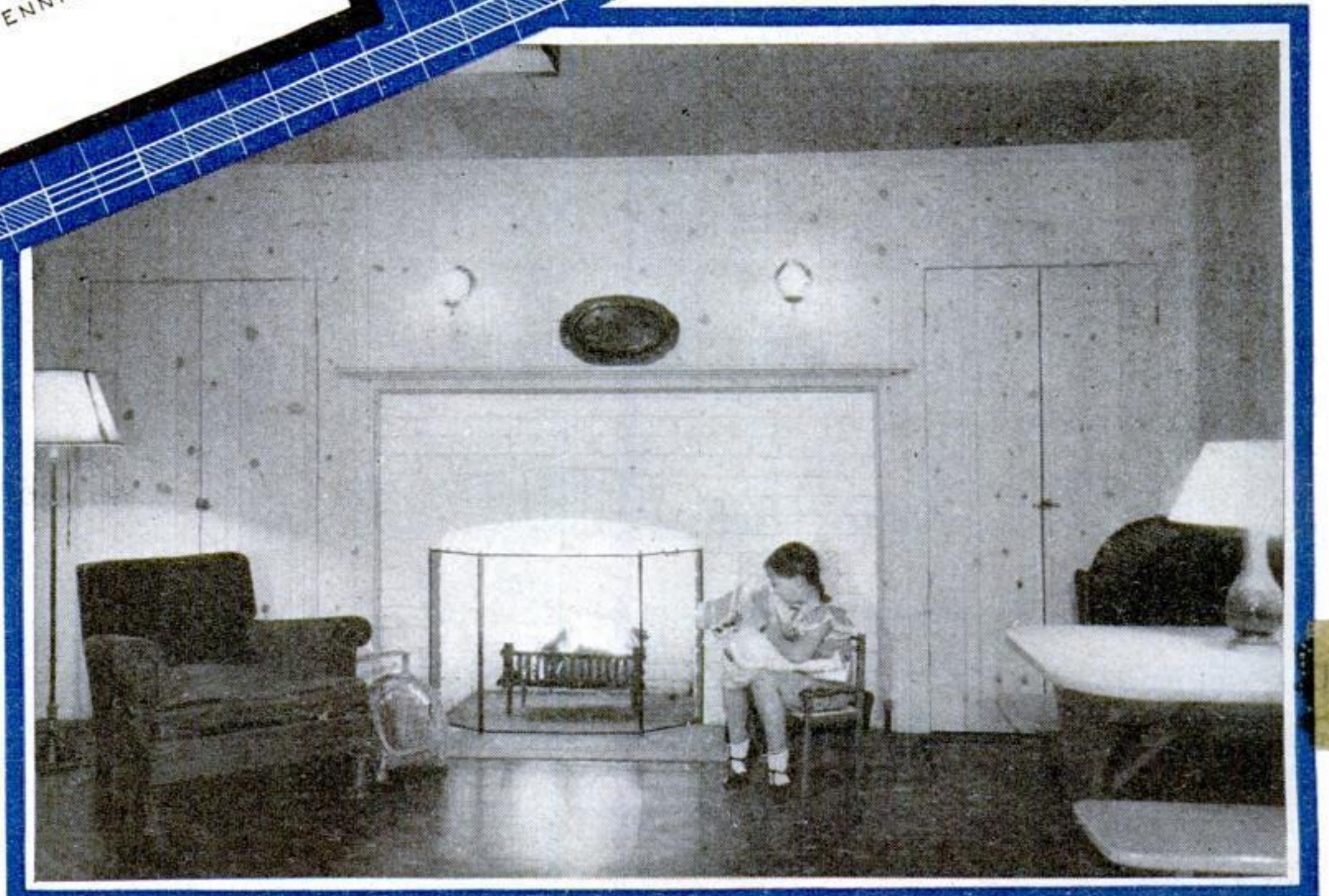
But no matter what type of construction you desire, the first step is to lay out your plan to fit the available basement space. On a large piece of paper draw 1/2-in. squares to represent square feet of floor space, and mark off your walls and partitions. From another piece of paper cut shapes to represent the floor area of the furniture you intend to use; do this to the same scale of 1/2 in. equals 1 ft. so that you can move them about on the plan to test various arrangements. Locate any built-in features to the best advantage, as in Fig. 1.

Should your basement consist of one large room, a smaller space can be partitioned off. Clear out everything movable and vigorously attack the cleaning job. Go after the ceiling first and work down. Kerosene-dampened rags are good for removing grease and soot from piping, and a stiff wire brush will take care of the rust. Later these cleaned pipes can be painted with aluminum or

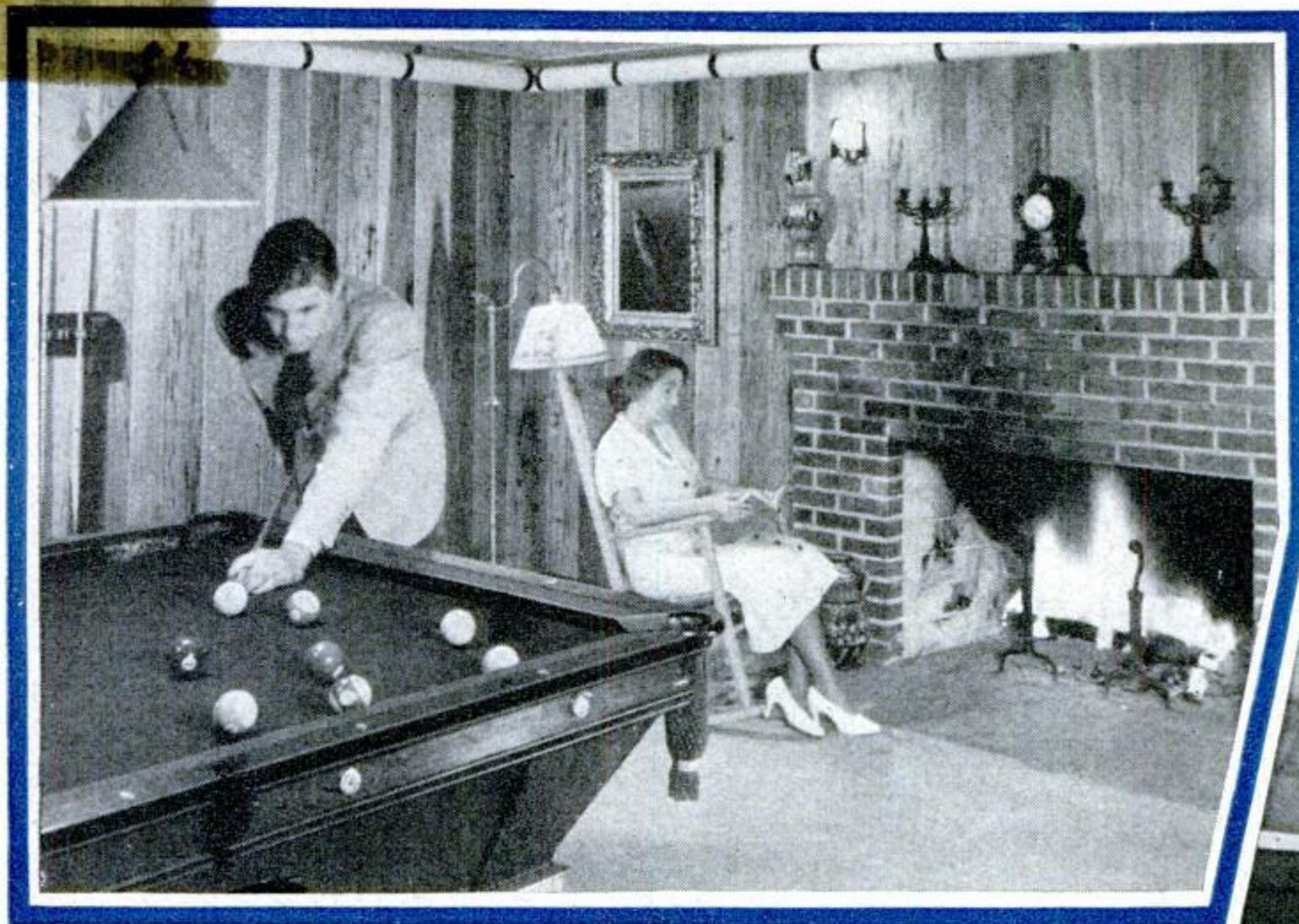
Sketch the plan on squares, and test the furniture arrangement with cards cut out to scale



Right, the side walls of this room in a Pasadena, Calif., home are plastered and tinted; the end wall is knotty pine; ceiling, wall board



in Your Basement



Walls of pecky cypress create a decorative background for the game room in the home of Arthur Ferber, Madison, N.J. Note the two-toned cement floor—red border and gray center. Right, the room under construction



the same paint used on the walls. Where the pipes are covered with insulation, white paint is effective, and an especially smart effect may be obtained by removing the straps and substituting chromium-plated brass bands (Fig. 3).

Usually the furnace will supply sufficient heat if it can be screened off without sacrificing warmth, as in Fig. 4. Two-by-fours are used for the framing, and the lattice is made of light battens, the squares being as small or as large as you wish.

In Fig. 5 is a "silo" type of furnace screen with the vertical boards spaced 1 in. apart for air circulation. The design in Fig. 6 is another that is easy to build, the upright boards being knotty pine or a less expensive material. A Venetian-blind effect, Fig. 7, completely conceals the furnace without restrict-

ing radiation of heat. In any of these arrangements, the inclosure could be built so that it opens into the adjoining room, as illustrated in the small plan drawing (Fig. 7).

Before building any furnace inclosures or partitions, you should decide what is to be done with the floor and walls. If the floor is to be painted, the method described in a previous article (P.S.M., June '37, p. 77) is excellent, although, of course, the painting should come after all other work is completed.

The concrete or brick walls should be waterproofed in localities where basements are subjected to a great deal of moisture. In this connection, see that the rain water from the down spouts is drained away from the walls. All chinks or openings on the inside should be calked with Portland cement—two parts of the latter to three of sand.

Waterproofing the walls can be done by

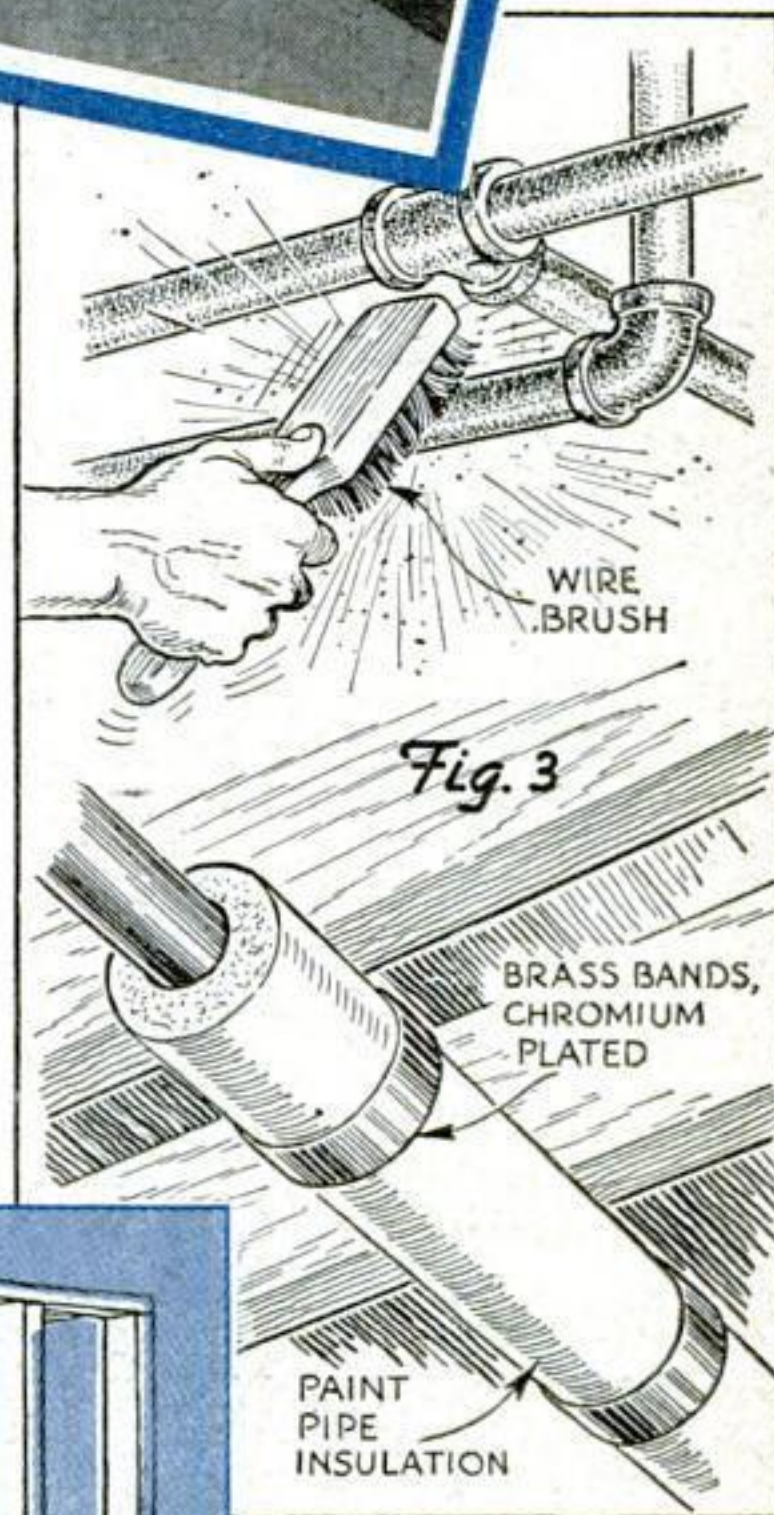
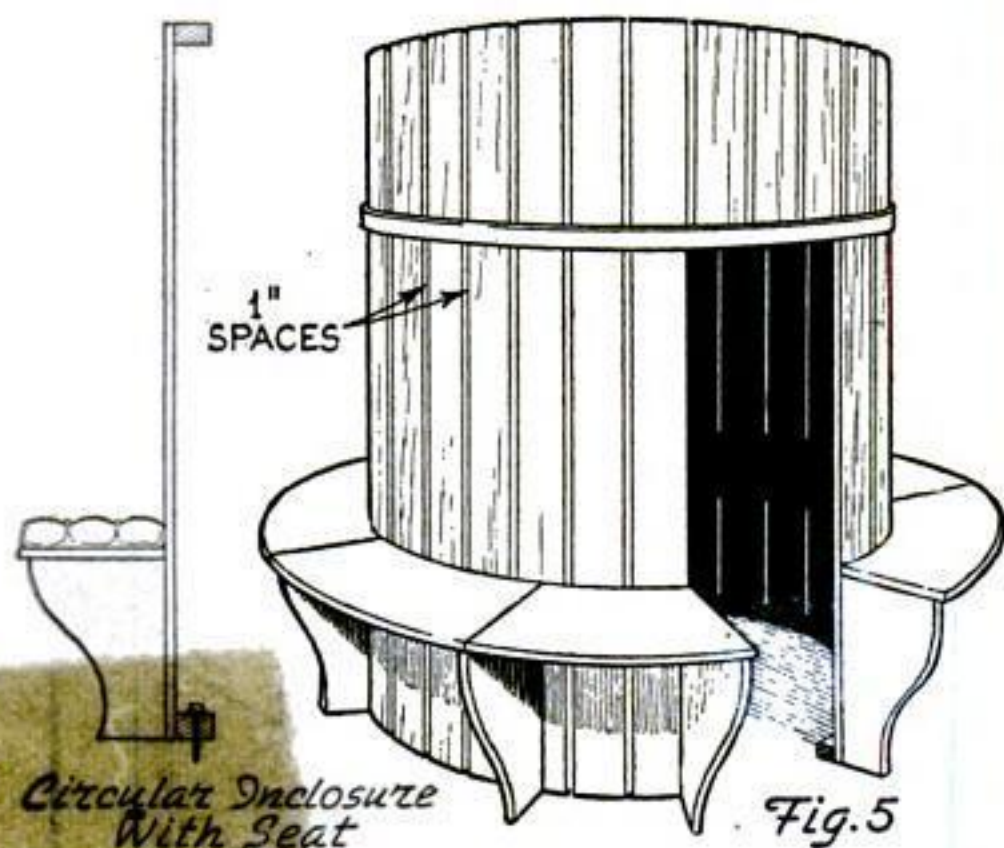


Fig. 3



When it is necessary to have the furnace right in the room, various ways of hiding it may be used. The one shown above is a so-called "silo" design of vertical boards

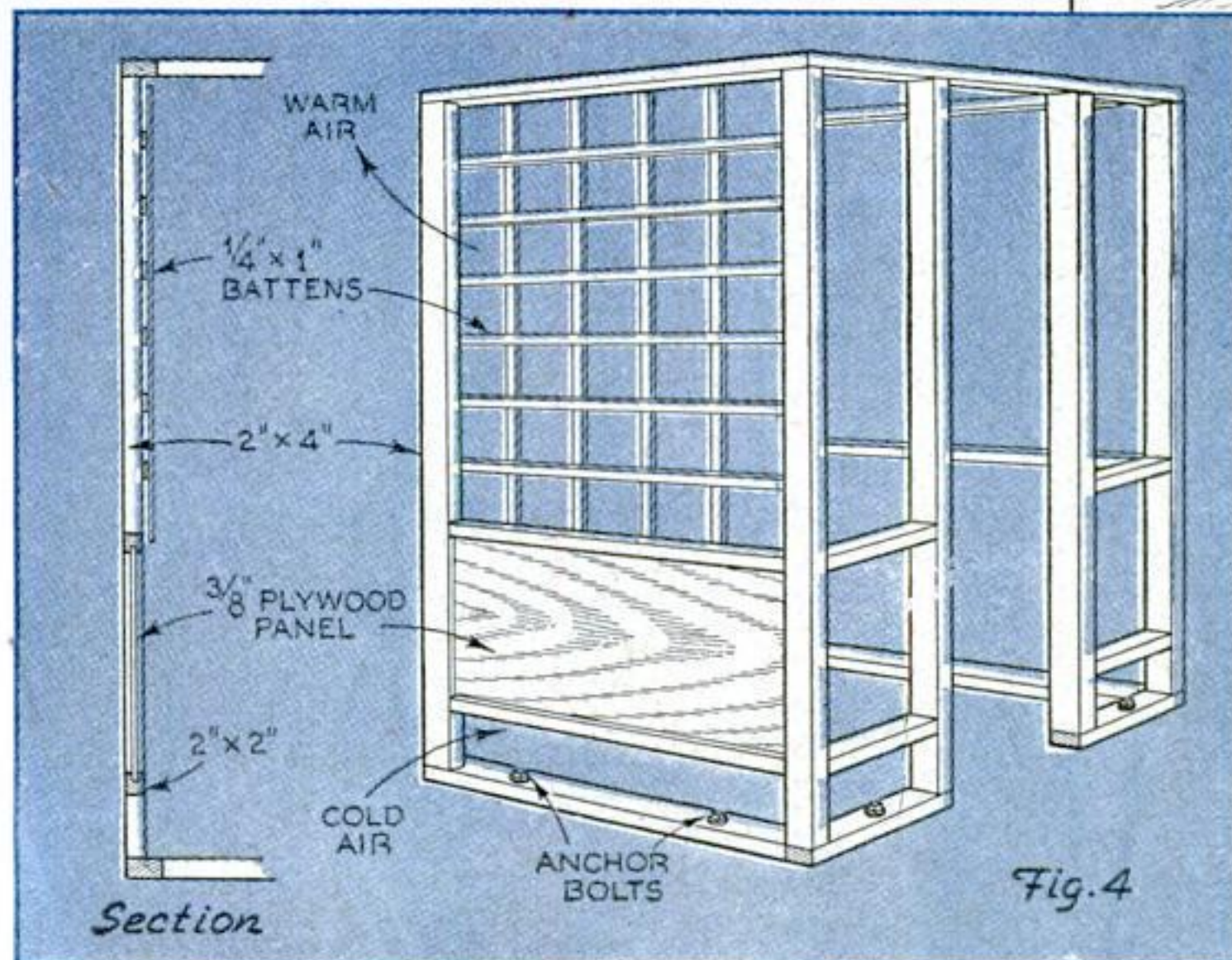
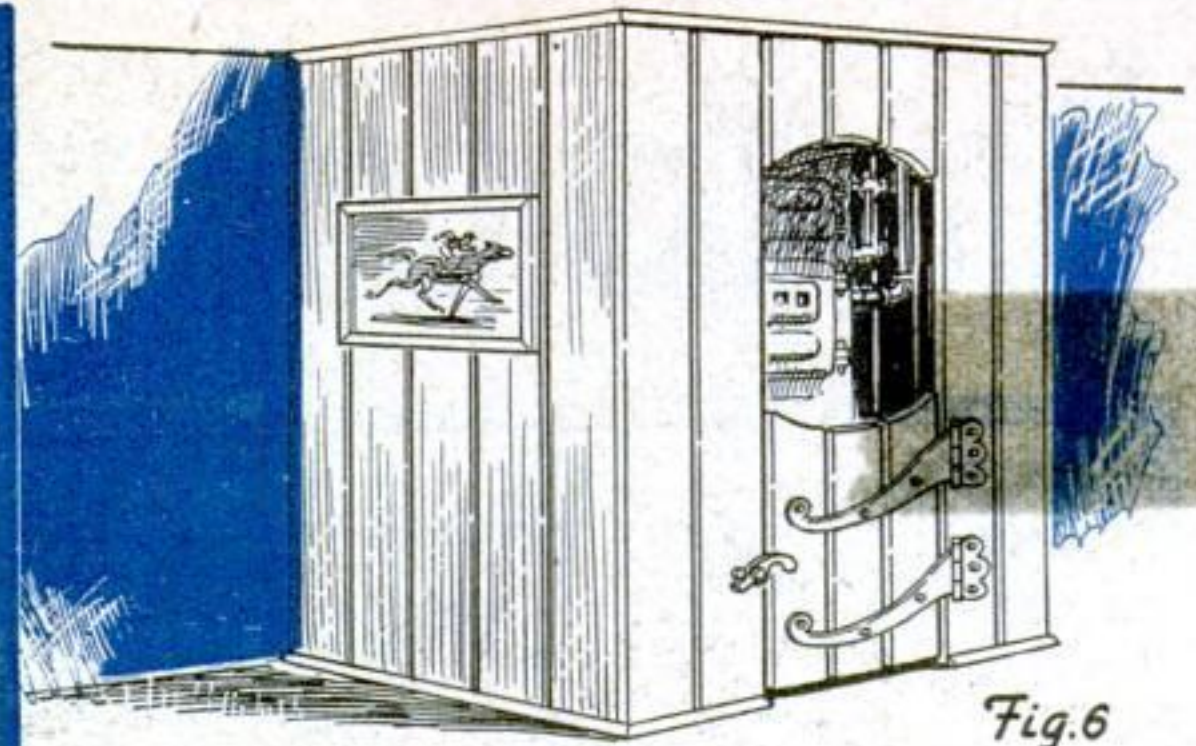
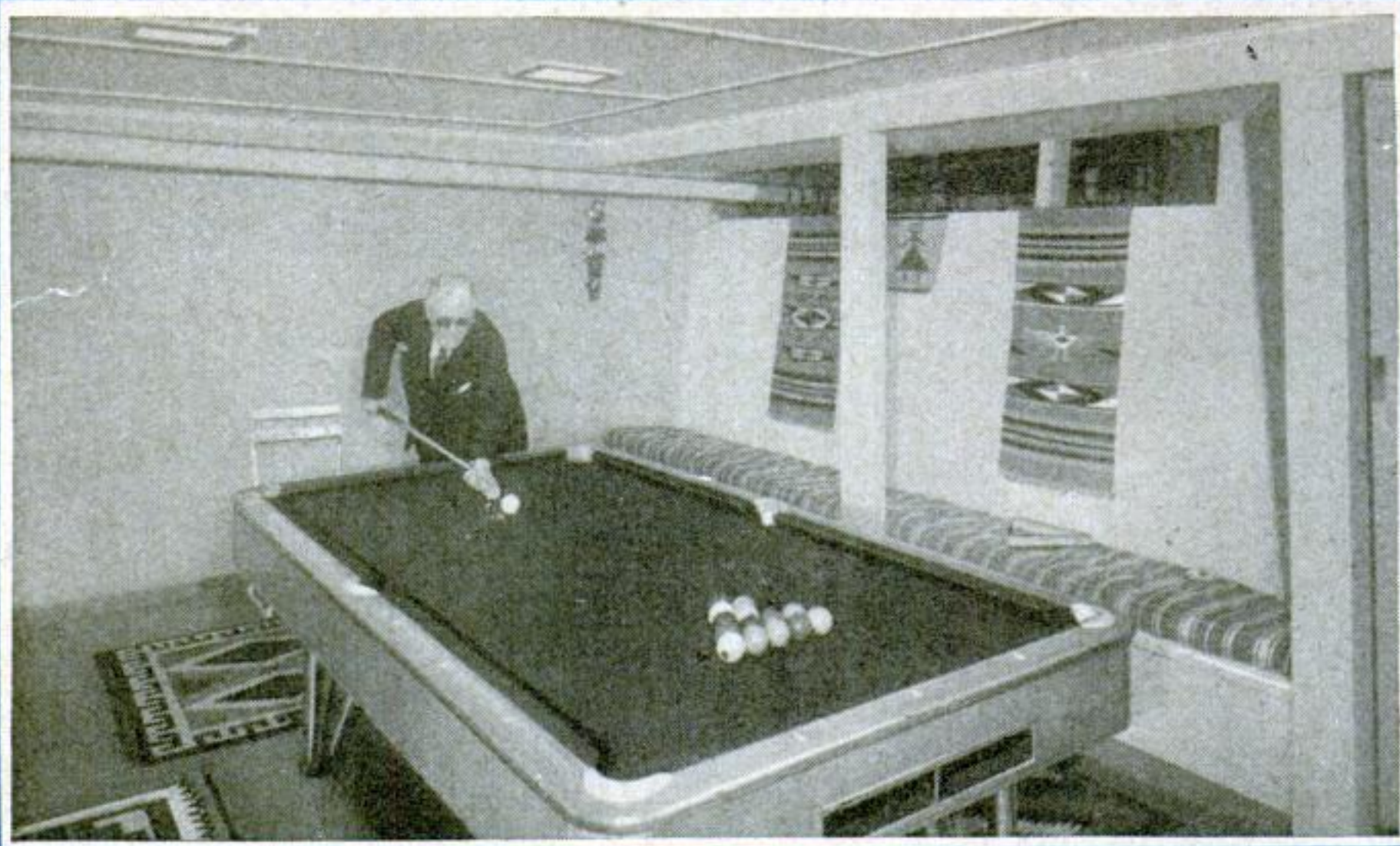


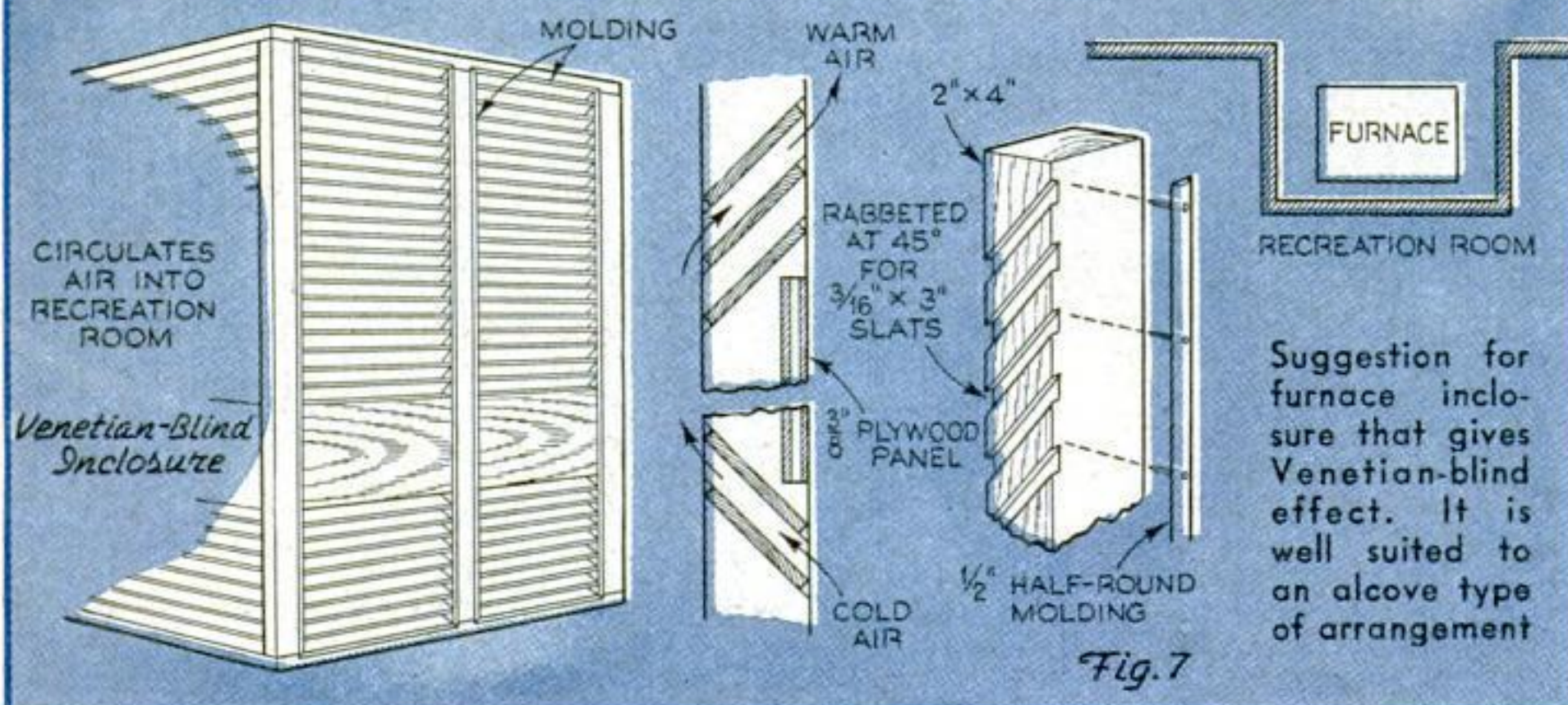
Fig. 4

If they cannot be concealed, pipes should be cleaned and neatly painted. Any insulation may be painted white, and the old straps replaced with chromium-plated ones

Left, an inexpensive furnace screen made to resemble a trellis



Left, room in residence of George Dawson, Altadena, Calif. The furnace heat comes through the rectangular openings over the seats. Above, camouflage of another type

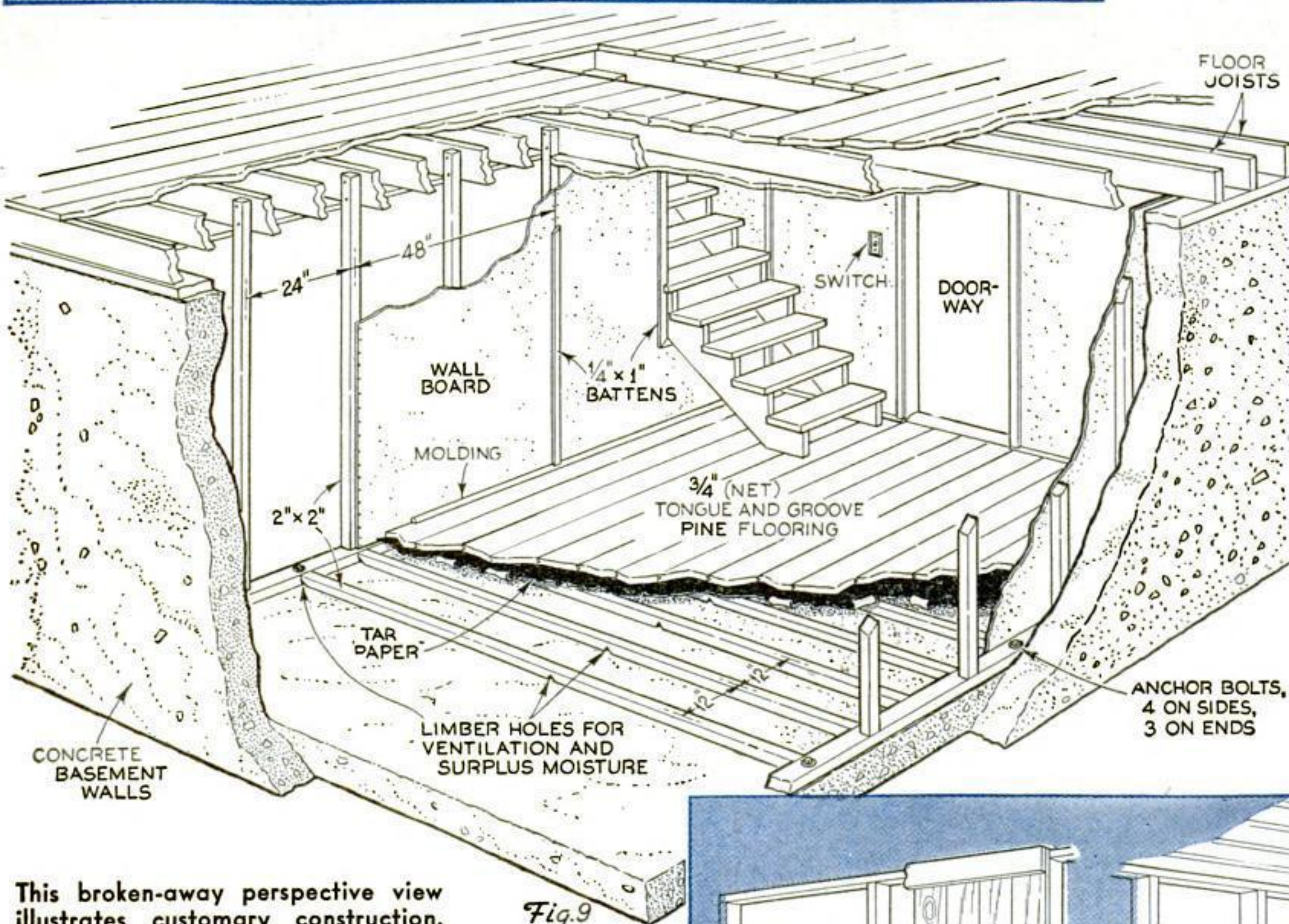


brushing on two or three coats of a thick, "pea-soup" mixture of waterproof cement and water, using a calcimine brush. Another way is to apply two coats of a mixture of one part casein waterproof glue and ten parts hydrated lime. Add water to give the proper consistency. A gallon of this will cover from 100 to 200 sq. ft. with two coats.

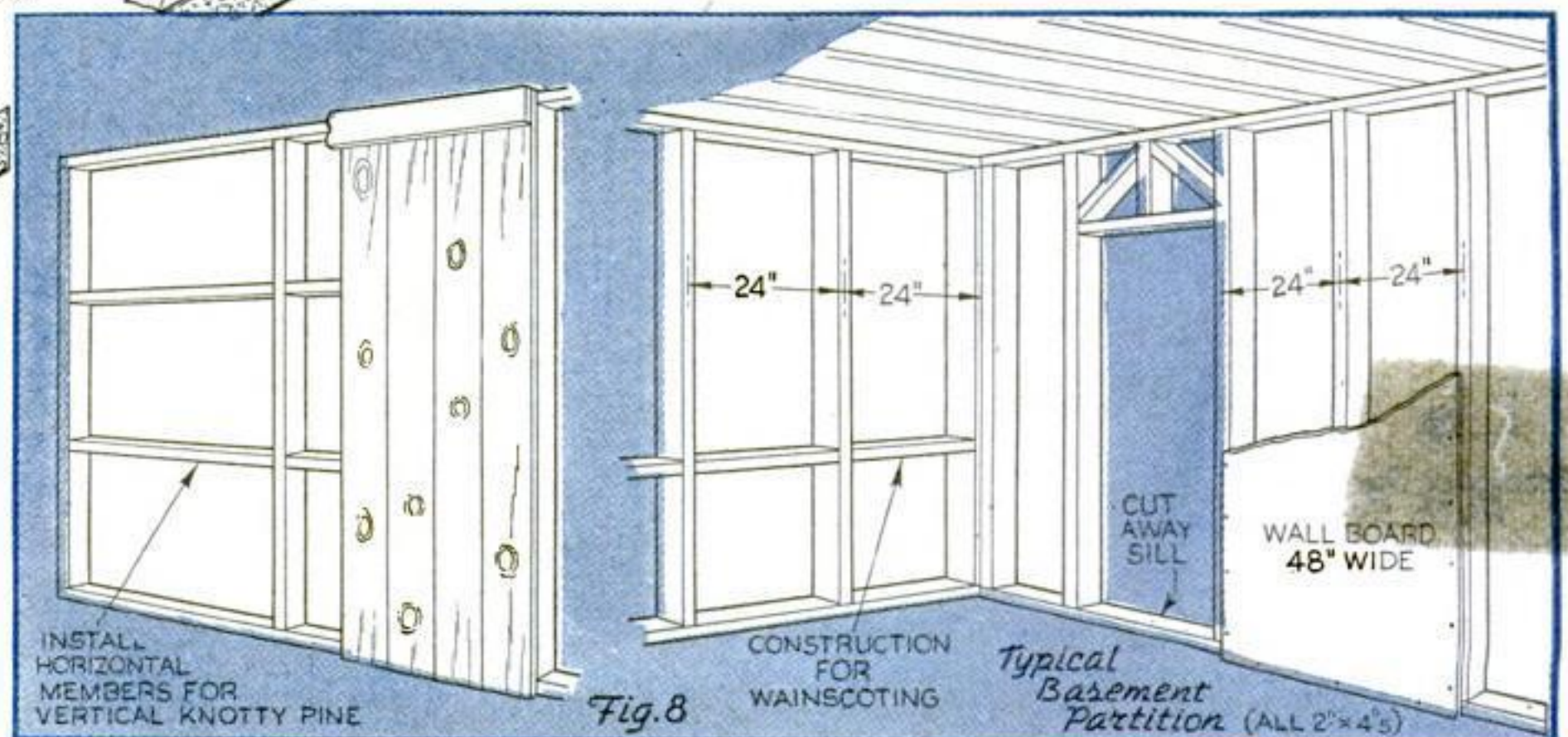
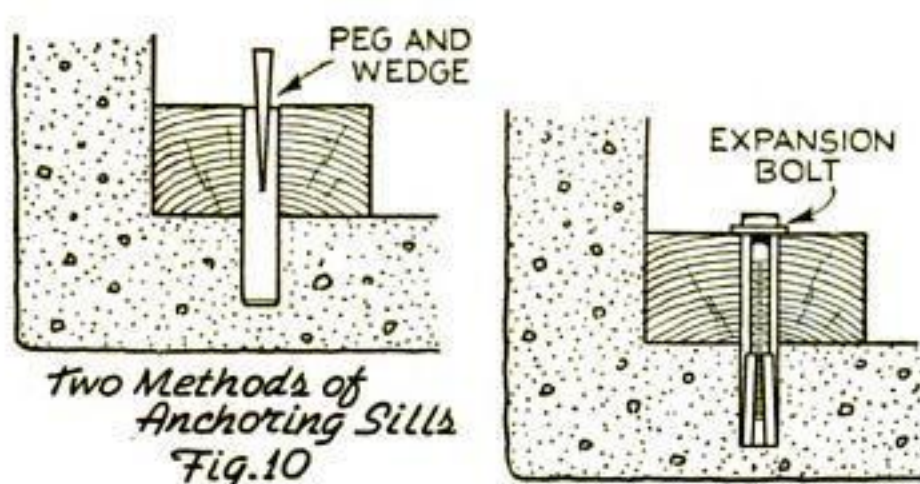
Taking a typical basement, Fig. 2, we shall follow out the construction step by step. In Fig. 8 are shown methods of building partitions. As wall board and plywood come in 48-in. widths, the studs should be spaced accordingly, that is, 24 in. apart on centers. Where vertical sheathing is used, such as knotty-pine boards, horizontal members should be installed as shown for additional support.

The cutaway perspective, Fig. 9, illustrates nearly all the details of construction of a typical room. First the sills are installed around the bottoms of the walls. These may be common two-by-four's secured with anchor bolts each 4 ft. or so. Holes are first made in the cement with a rock drill and hammer. Standard expansion bolts can be used to hold the sills, or 5/8-in. dowel plugs may be set in holes bored that size, and a wedge driven in, as shown in Fig. 10. Another method is to fill the hole in the cement with melted sulphur and set in the bolt before the sulphur hardens.

Studs—the 2 by 2-in. size is (Continued on page 116)



This broken-away perspective view illustrates customary construction. Below, how to anchor the sills. At right, ways of building partitions





The dipping receptacle is an old 500-gal. tank, cut longitudinally and with a drain rack in back. The log hoist or "spinning jenny" is shown below



Creosote Dip for Logs

CONSTRUCTED CHEAPLY

AN INEXPENSIVE rig for creosoting guard-rail posts was improvised in a Southern CCC camp as illustrated. An old 500-gal. oil tank was cut longitudinally for the dipping receptacle and buried a few inches in the ground. A drain rack 8 ft. long and 5 ft. wide was constructed of scrap 2 by 4's and 2 by 6's alongside the tank. A pitch of 8 in. across the 5 ft. was allowed so that the excess creosote would drain back into the tub. The rack was covered with old tin roofing material with an apron leading from its edge into the tank.

The hoisting rig is one colloquially known as a "spinning jenny." Its support is a 6 by 6-in. post 7 ft. long held vertical by 2 by 6-in. spider legs, which

are braced with diagonal pieces. This "on-the-ground" device remains stationary when placed, but permits easy relocating. A 1-in. iron pin protrudes from the rounded end of the post about 2½ in. A 16-ft. cypress pole with a maximum diameter of 6 in. serves as the lever. The fulcrum is 4 ft. from the larger end where a 1½-in. hole bored two thirds of the way through acts as a socket for the pin.

Double log hooks hung from the lifting end of the pole readily grab any size material up to 24-in. in diameter and, if properly placed, hold the logs in a hori-

zontal position. A rope hung from the other end of the pole facilitates handling distant posts.

This rig cost nothing in materials, saved a great deal of labor and considerable creosote, and allowed much greater penetration than a brush application would give.—JAMES S. KLAR.



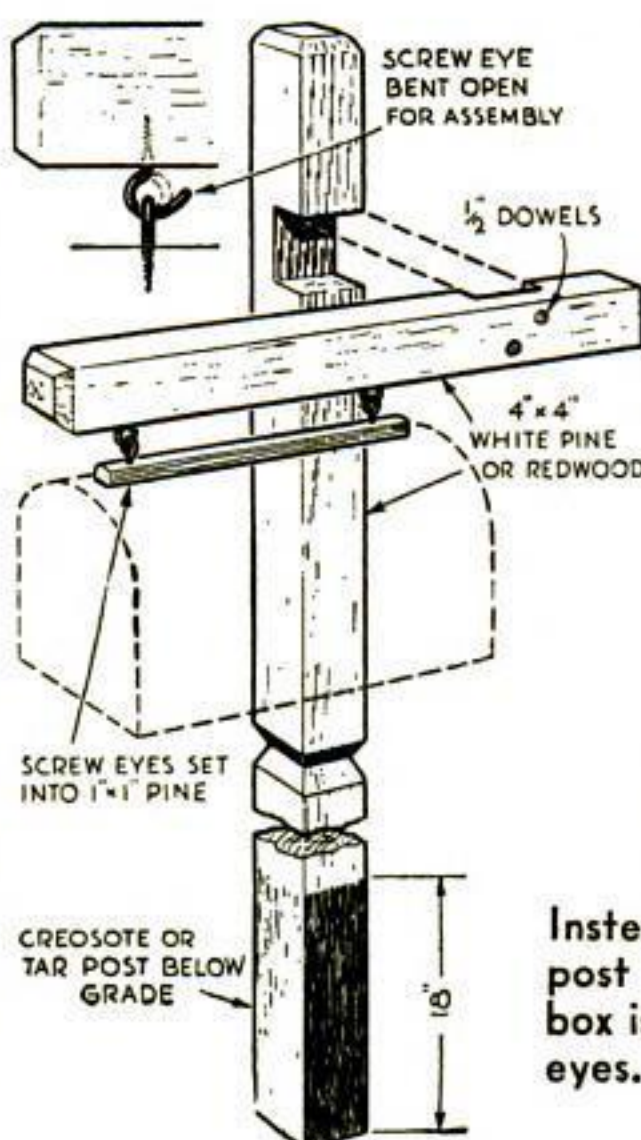
Sander Disks Cemented with Auto-Top Putty

AUTO-TOP putty, a pasty black material, is excellent for attaching sanding disks to a power-sanding tool. Spread the putty over the back of the abrasive disk and face of the power-driven disk with a knife, then allow it to dry for a few minutes before pressing the two surfaces into firm contact. The putty holds tenaciously, but the abrasive disk can be removed without difficulty by pulling at the edge and slowly stripping it away.—K. M.

Neat Standard Supports Rural Mail Box

THIS workmanlike standard for a rural mail box is an improvement over the usual plain post. If an ivy vine is trained over the upright, it presents a pleasing appearance; at the same time, the box is readily accessible to the postman and the home owner.

Redwood or cypress is a durable wood for the post, but white pine can be used if the portion set in the ground is well creosoted or tarred. For maximum strength, half-lap the cross arm into the post, glue the joint with waterproof casein glue, and reinforce it further with dowels. The wood above ground can be left to weather naturally, or it may be stained or painted neatly.—D. HIXON.



Instead of being set on top of a plain post in the usual way, this rural mail box is suspended by means of heavy screw eyes. At left, how the standard is made

The ALABAMA,

By Capt. E. Armitage McCann



FOR two years during the Civil War, the Confederate raider *Alabama* struck terror on the high seas. She did an incalculable amount of damage to Federal ships and supplies. One ship alone among the nearly seventy vessels she captured—the *Sea Lark*—was estimated to

be worth \$550,000.

Our model of this extraordinary ship is built on the scale of 3/32 in. equals 1 ft. of the original. Last month instructions were given for shaping the hull, but there is still some work to be done before we can call the hull complete and paint it.

If you missed the preceding issue and wish to construct the model, look up a back copy and get to work. You will be able to catch up without difficulty.

To finish the head, cut strips for the trail boards to the shape shown. Glue and nail the ends to the stem. Then bend the trail boards into a concave curve, but not quite close into the corner, and glue and nail the after ends to the hull. The center panel of the trail boards should be recessed slightly, as if there were moldings top and bottom. This effect is easily obtained if you use 1/16-in. three-ply wood and cut away one ply on the outside to form the recessed center.

The 1/8-in. hawse pipes may now be bored in such a way as to point

up and aft. As the windlass is supposed to be under the forecastle, the upper ends of the hawse pipes will not show.

The trail boards are black with white scrollwork, and the hawse pipes are red.

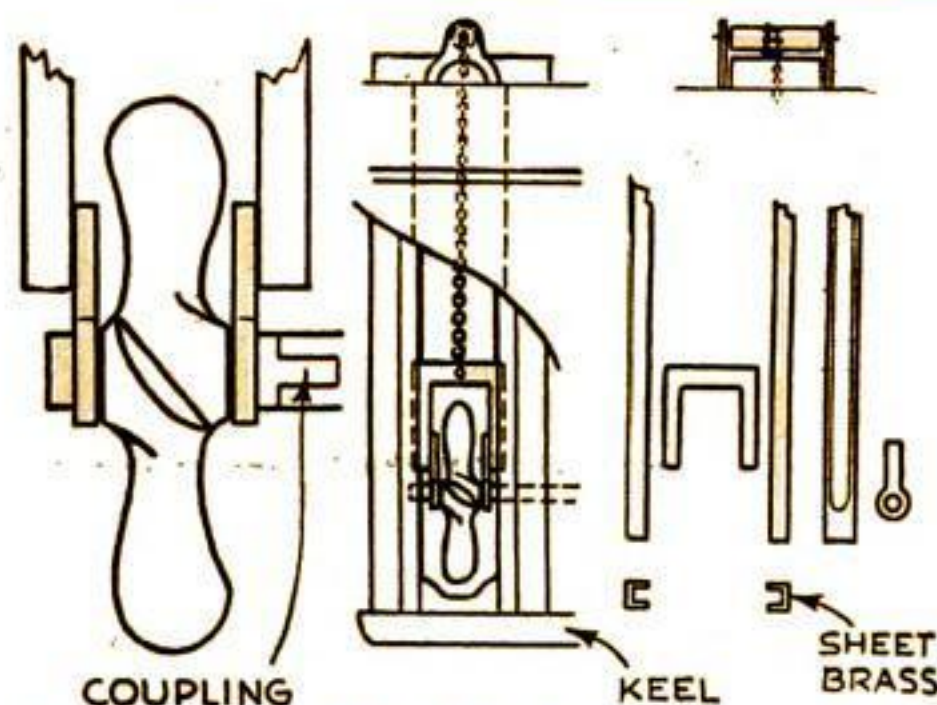
Catheads 1/8 by 1/8 by 1 in. are nailed to the deck at an angle to the hull so they point slightly upwards. Their ends should be drilled for two or three sheaves, and eyebolts are needed on the fore sides.

Running from underneath the catheads to the end of the stem are the headrails. They have a downward curve, but no side curve.

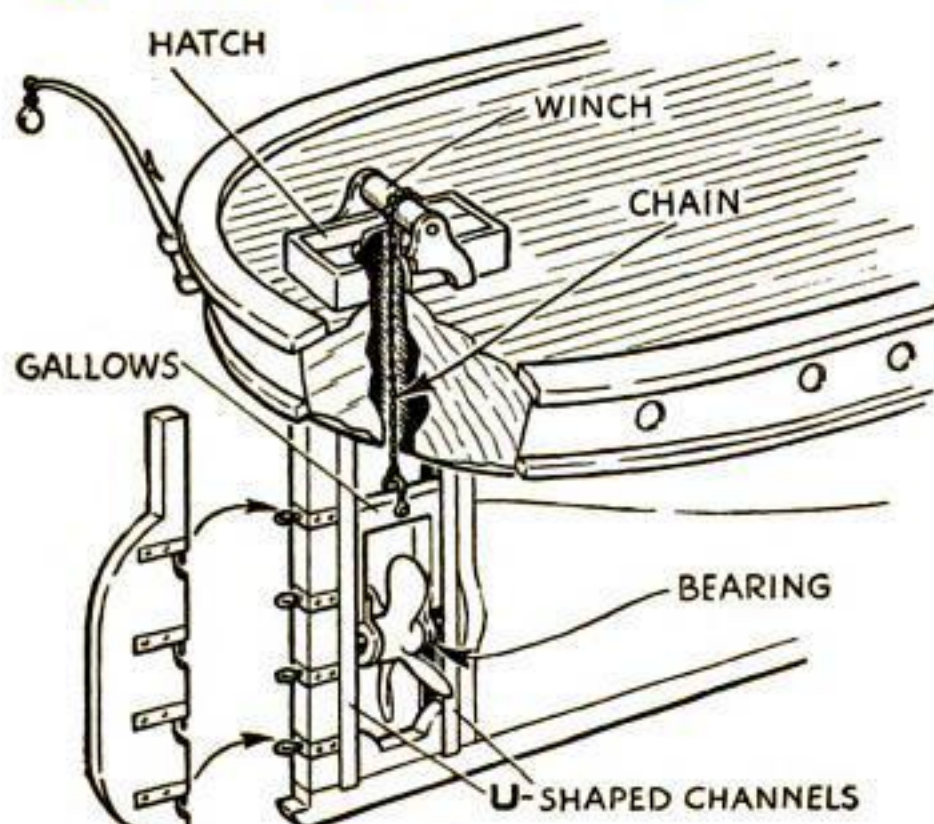
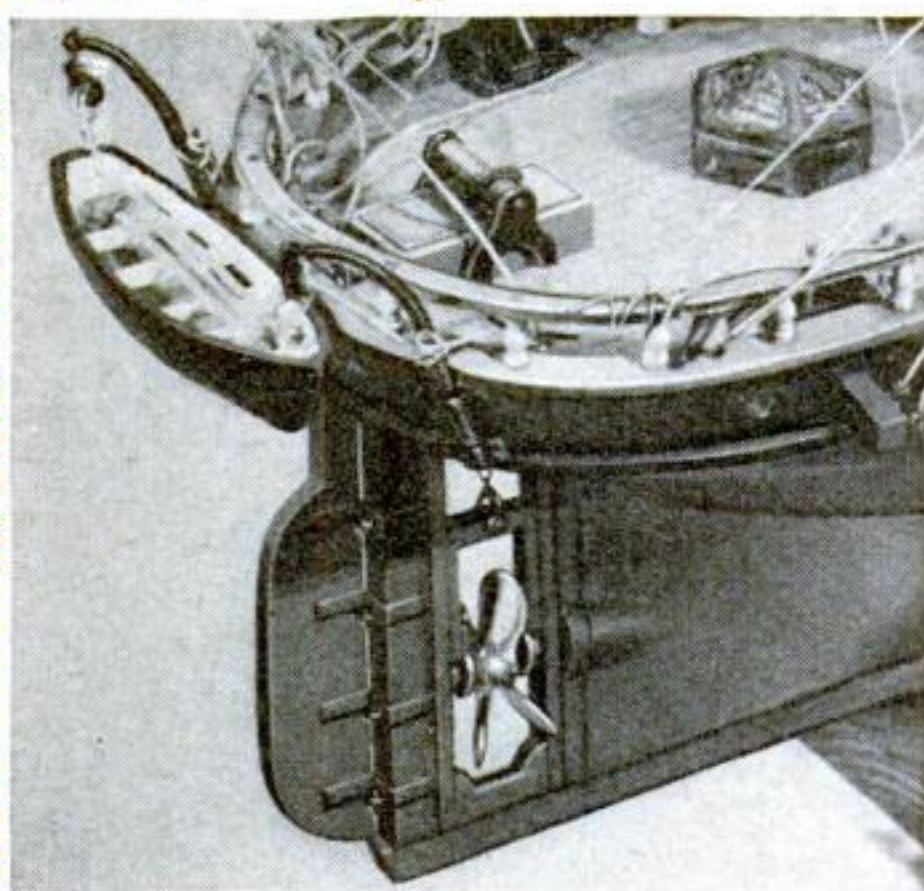
Knightheads are solid posts set into the deck in line with the inside of the stem. They are spaced apart a scant 1/4 in. Note that they have a pinrail notched into them, and firmly fixed eyebolts for the forestay.

We now turn our attention to the stern, where the *Alabama* had a hoisting propeller—one that could be uncoupled and lifted from above. The mechanism does not have to be shown on the model, but it is an interesting feature. There were several methods of lifting and coupling in use. I chose the simplest, and the construction is shown clearly in the detail drawings.

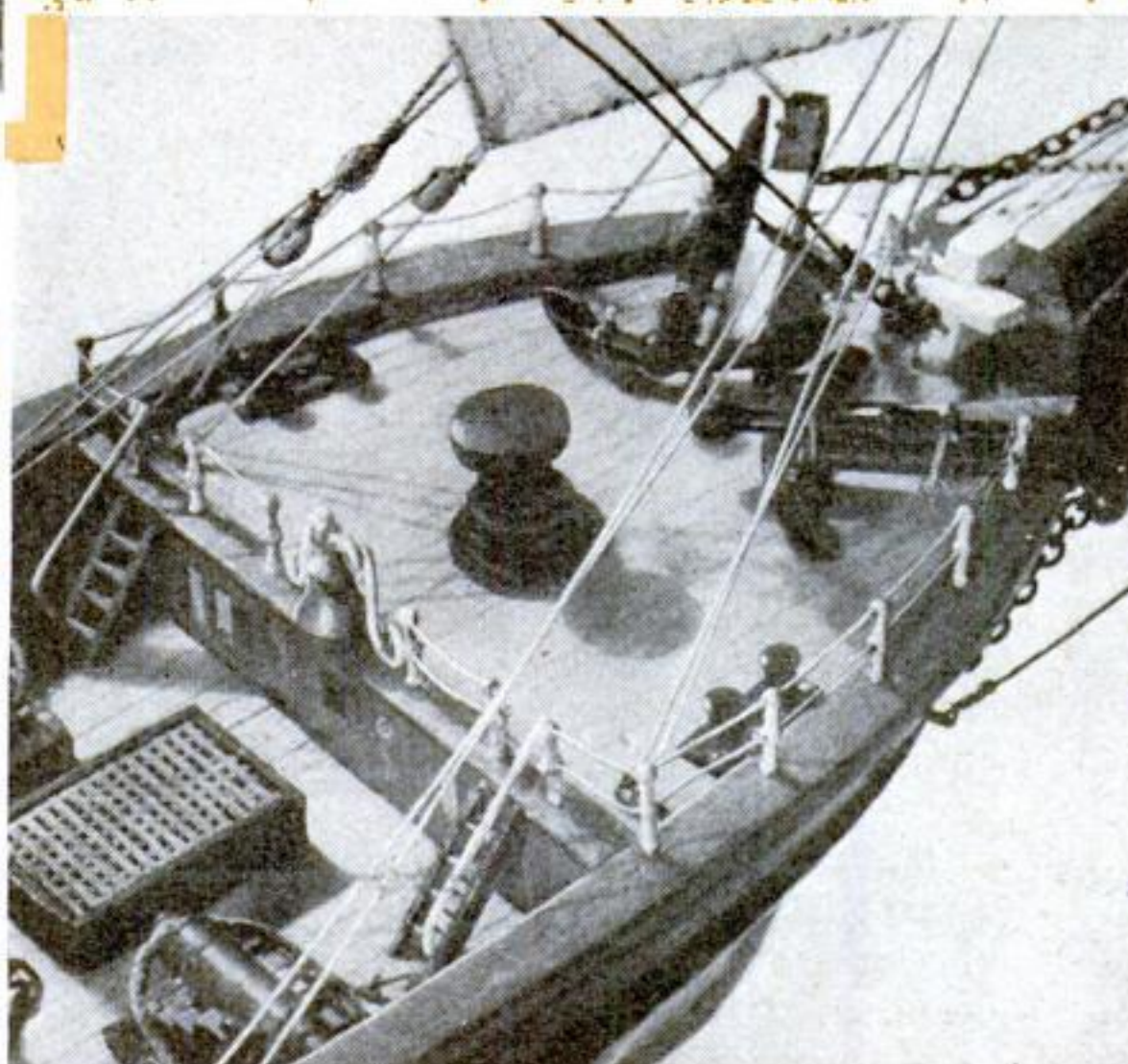
The propeller probably was four-bladed and for the model should be about 7/8 in. in diameter. The shaft hangs in a gallows made of three pieces of metal soldered together like a square, inverted U. To the lower, inside edges of this frame are soldered thin pieces that project down as shown and are drilled for the short propeller shaft. The inner end of the shaft is notched to form a tongue, which engages a groove in the shaft proper, and this tongue and



Half-size details of the hoisting propeller, and an enlarged view of the shaft coupling



Sketch of stern showing rudder, propeller, hatch, and winch. Compare this with the photo immediately above



POOP-DECK VIEW, LOOKING AFT



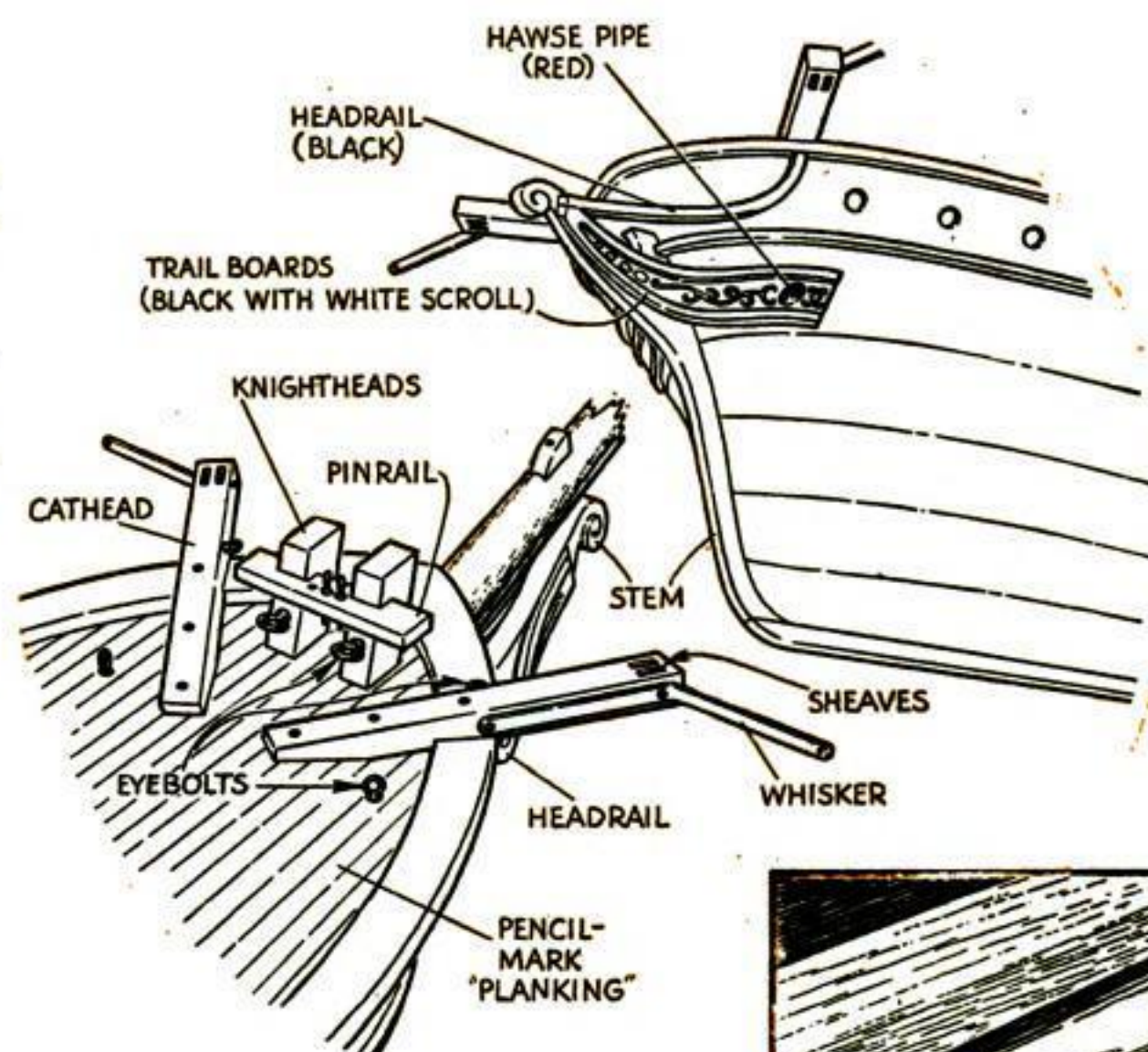
FORECASTLE VIEW, LOOKING FORWARD

Poop and forecastle bulkheads. Ladders, rails, and bell are also shown, but will not be added until later. Left, the forecastle deck

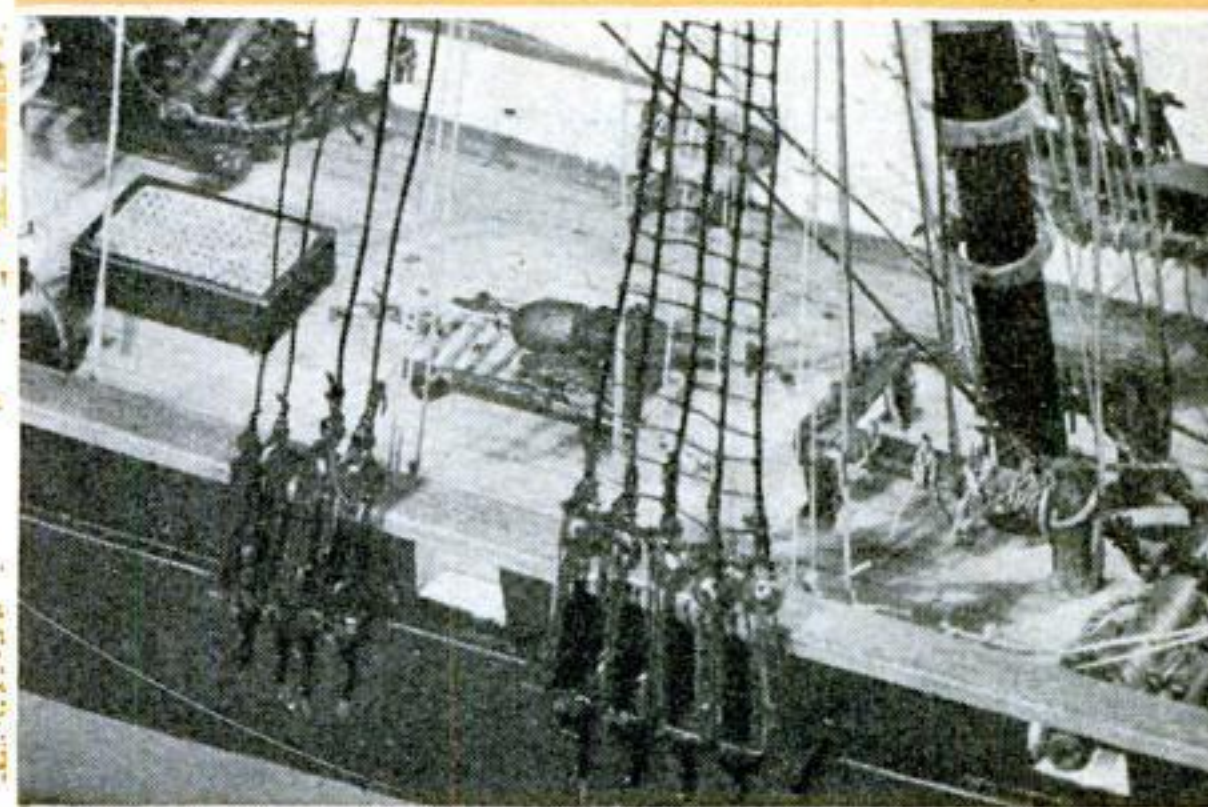
Famous Confederate Raider



The "Alabama" model with all sails set. Captain McCann completed the model just before his death (see P.S.M., Feb. '38, p. 78). Although he could work on it only an hour a day towards the end, his incomparable craftsmanship never faltered. The model is in every way a masterpiece



In circle, two sketches to make clear the construction of trail boards, headrails, catheads, and knightheads. The whiskers are added later. Right, a port light. Below, the deck aft the foremast

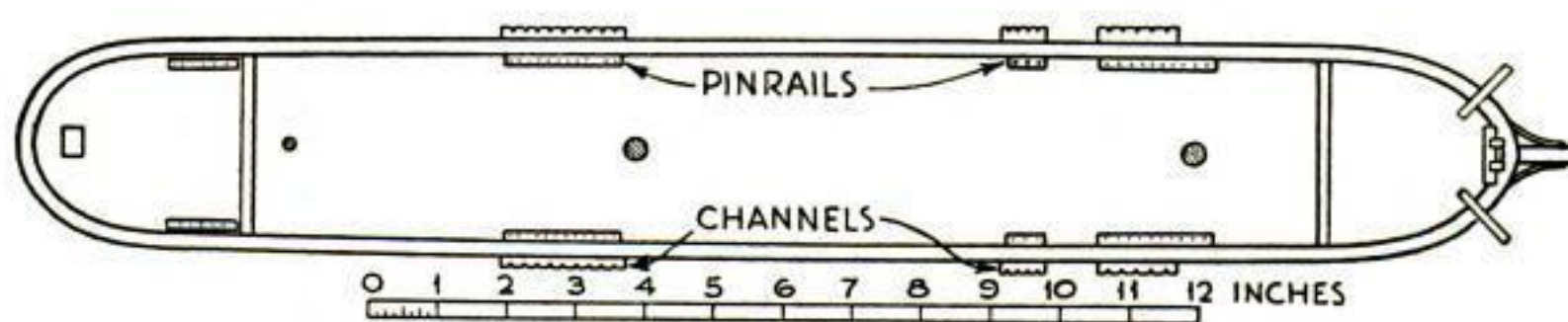
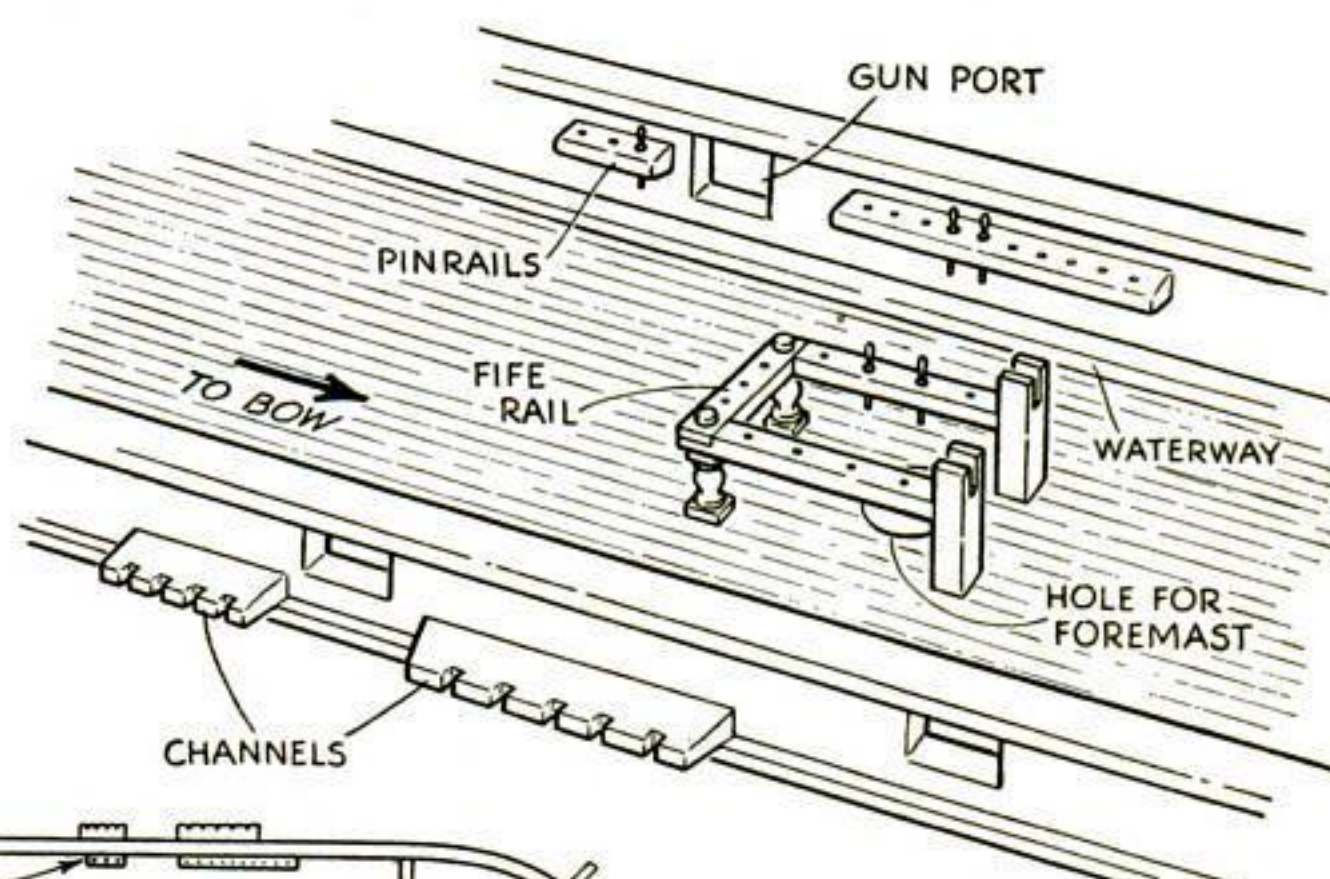


groove form the coupling when in use. The gallows slides in U-shaped channels fastened to the sternpost and stern frame. A rectangular hole is cut in the counter above the slides (see drawing on page 80, February issue), and this is covered on deck with a hatch. The chain for hoisting goes through this hatch to a winch above.

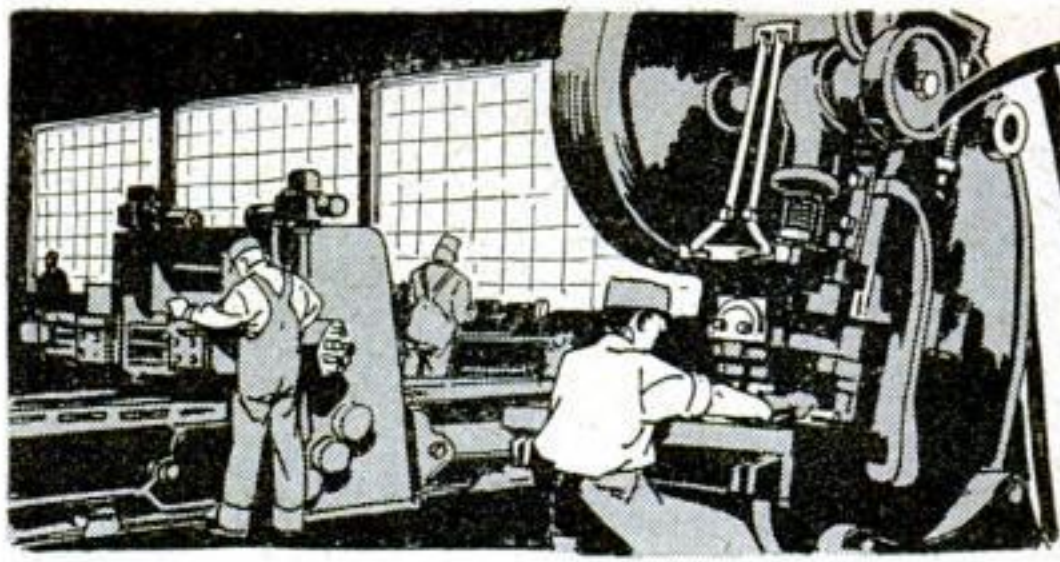
When all the parts are prepared, set the gallows in its slideway, fasten the stern-frame post to the keel and hull, and fill in between at the bottom with a piece of wood shaped to fit.

The rudder is made and hung as shown, with regular gudgeons and pintles on their straps or, if a simpler construction is desired, eyes may be made from pins and set in the stern frame, and bent-pin pintles set in the rudder.

Channels are made from a $\frac{1}{8}$ by $\frac{3}{16}$ -in. strip and applied where indicated on the small deck plan. They are like shelves, slightly thicker at the back than the front, with their upper surfaces horizontal. Notches are cut in them at the correct angles to take the chain plates. They are firmly nailed on the hull just above the molding. (Continued on page 112)



How to make the channels, pinrails, and fife rails. The location of masts, pinrails, and channels is given at left



Better SHOP Methods

Drab-Colored Shops Are Out!

HINTS ON PAINTING WALLS, MACHINES, AND FIXTURES
TO ASSURE MAXIMUM SAFETY, COMFORT, EFFICIENCY

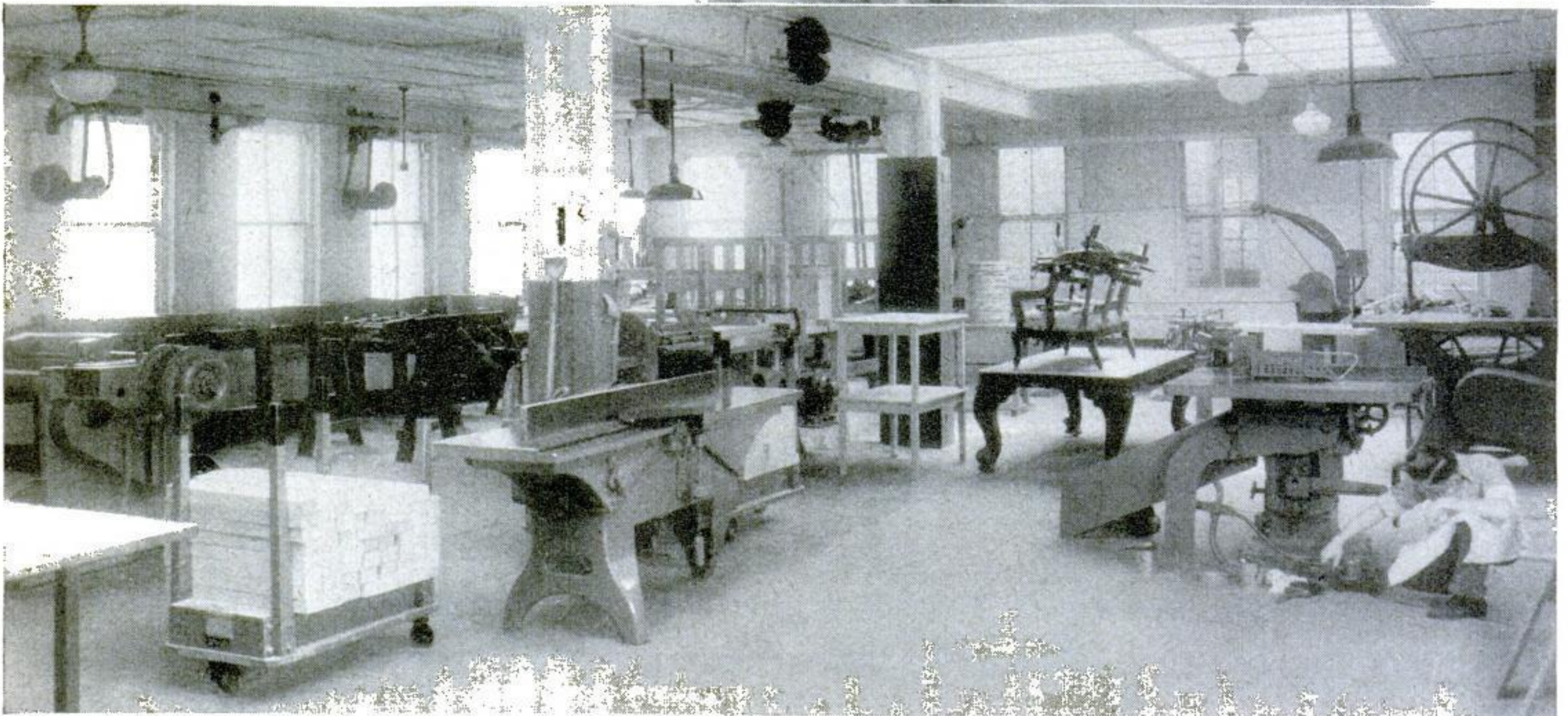
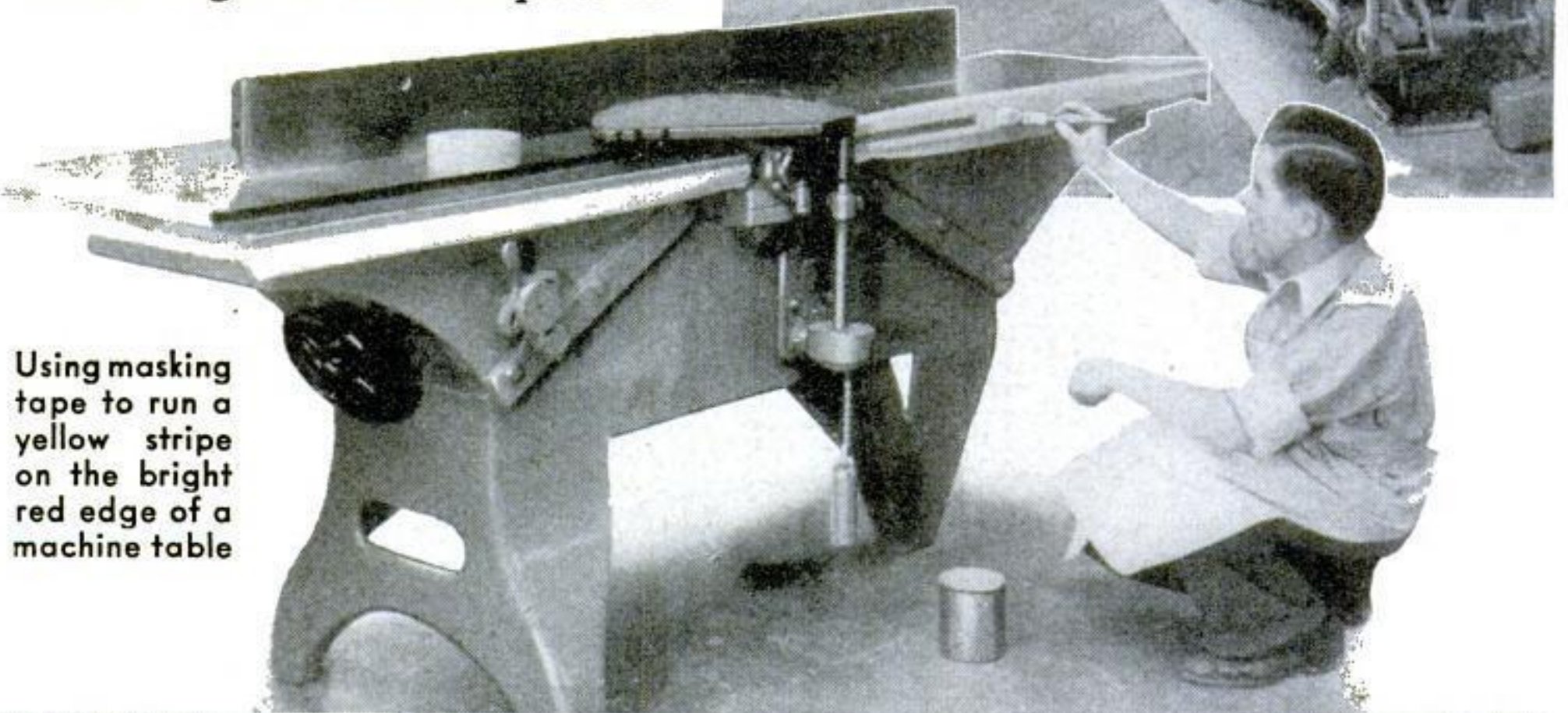
By
RALPH G. WARING

IN THIS day of marked changes in business methods, plant design, and operation, it behooves every superintendent, whether he has charge of a large or a small shop, to realize the importance of good painting and lighting. Where needed changes are undertaken under competent supervision, the work can be done at no great cost, and it will later pay for itself many times over in improved efficiency and operating comfort.

Outstanding in this respect is the modern windowless plant. It offers to the architect, the management, and the workers the ideal medium through which adequate light values, essential fresh air, as well as proper machine orientation and operation, are definitely assured.

Contrasted with glass window lighting, artificial light values obtained with the new type of light bulb and modified mercury units (shown at right) throwing 95 percent of illumination against a properly finished ceiling are so near ideal daylight that only a technically trained engineer with adequate in-

Using masking tape to run a yellow stripe on the bright red edge of a machine table

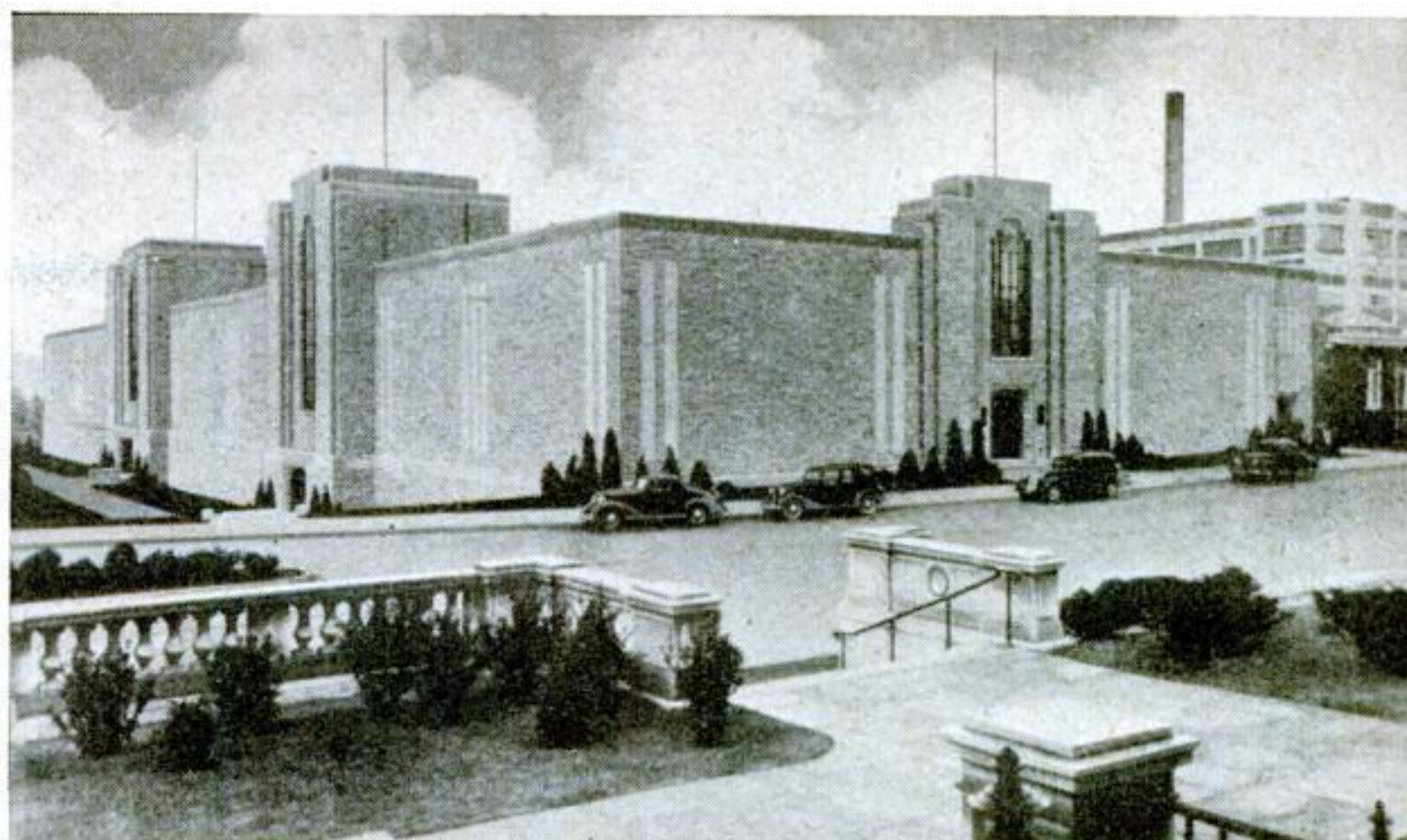


Excellent lighting and painting in a cabinet shop. The machines are jade green, ceiling and side wall white, columns tan brown up to 5 ft.

LIGHT REFLECTION VALUE OF COLOR IN PAINT

Color	Reflection (percent)	Color	Reflection (percent)
White	84	Buff	55.4
Cream	70.4	Light green	54.1
Light pink	69.4	Light gray	53.6
Ivory	64.3	Light blue	45.5
Yellow	60.5	Aluminum	41.9
Flesh	56	Sage Green	41

Colors have now entered the up-to-date shop and factory. Instead of being painted black or gray, machines are often jade green, straw, or light tan



Exterior of new windowless, air-conditioned chocolate plant at Hershey, Pa. The artificial illumination is like daylight, but much more uniform

struments can detect any difference. These units consist of standard glass lamps grouped together with bulbs of improved mercury lamps, inclosed in a specially designed reflector.

Whatever type of illumination is used, twenty foot candles at the working-table area are desirable, although for fine detail work the factors must be increased.

Superintendents are now aware that they can no longer escape the effects that neglect of good painting and lighting have on their shop morale and production schedules. The day is rapidly drawing near that will mark the end of dirty millrooms and machine shops.

In cases where whitewash of good quality has been used in the past, only a scratch brush is required to remove an occasional blister or peeling area.

By slightly thinning the first coat of any good white eggshell enamel of the type intended for mill use with a mixture of four parts of commercial turpentine and one part of pure turps, the increased penetration will be sufficient to penetrate the whitewash and secure good anchorage. Use little or no thinner on the second coat.

Where the calcimine work was poorly done or adhesion is bad, the whitewash must be washed off, before painting, with a trisodium-phosphate washing compound. Allow adequate drying time. It pays in the long run to wash off accumulated dust and grime.

In the case of the very modern print shop of the Hershey Chocolate Co., of Hershey, Pa., whose windowless plant is illustrated, all machines were cleaned with trisodium-phosphate washing solu-

tions, dried, wiped with clean rags and alcohol to destroy the last traces of oil, and then painted with a rich, Delft-blue, oilproof machine enamel of a tough, quick-drying type.

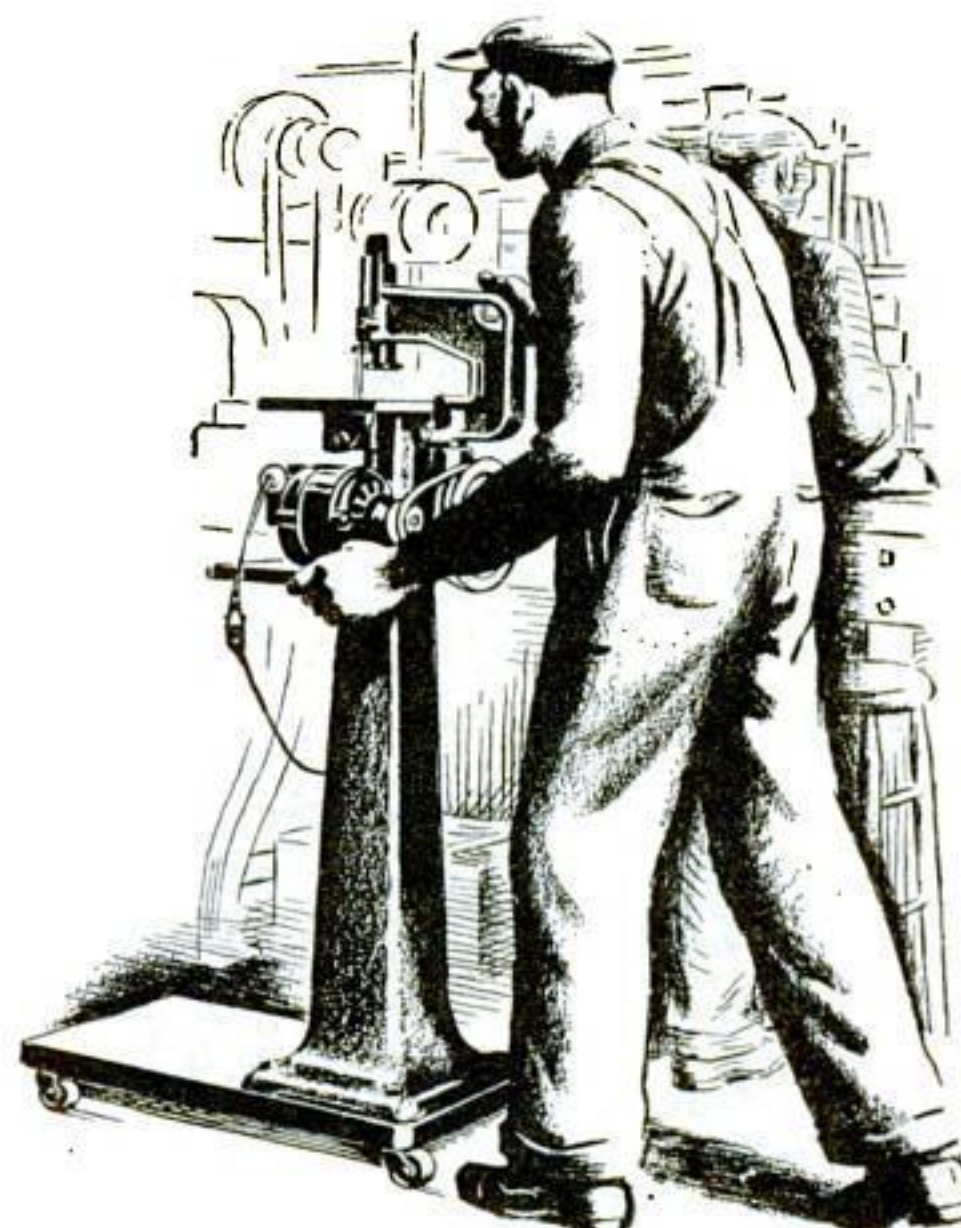
The floor is of oiled maple; pillar bases are light gray; the upper portion is a bright yellow; side walls are glazed hollow tile of a mottled-tan color, and the ceiling is a bright buff in order to avoid too great a variance between the glazed tile and ceiling areas. Table tops are mahogany, and waste cans light blue. All colors were chosen for their value under artificial light.

In the average shop, a maximum of white ceiling and side wall should be provided to conserve the light from natural sources. Under no circumstances should sash be painted black or deep gray (*Continued on page 108*)



Wooden Form Aids in Taking Dent from Horn

THE simplest way to remove dents from the bell of the horn of a musical instrument is to turn a piece of hardwood to a size and shape that will just fit down into the bell. The dents are then carefully and gradually worked out by using a lead hammer.—W. F. MESSENGER.



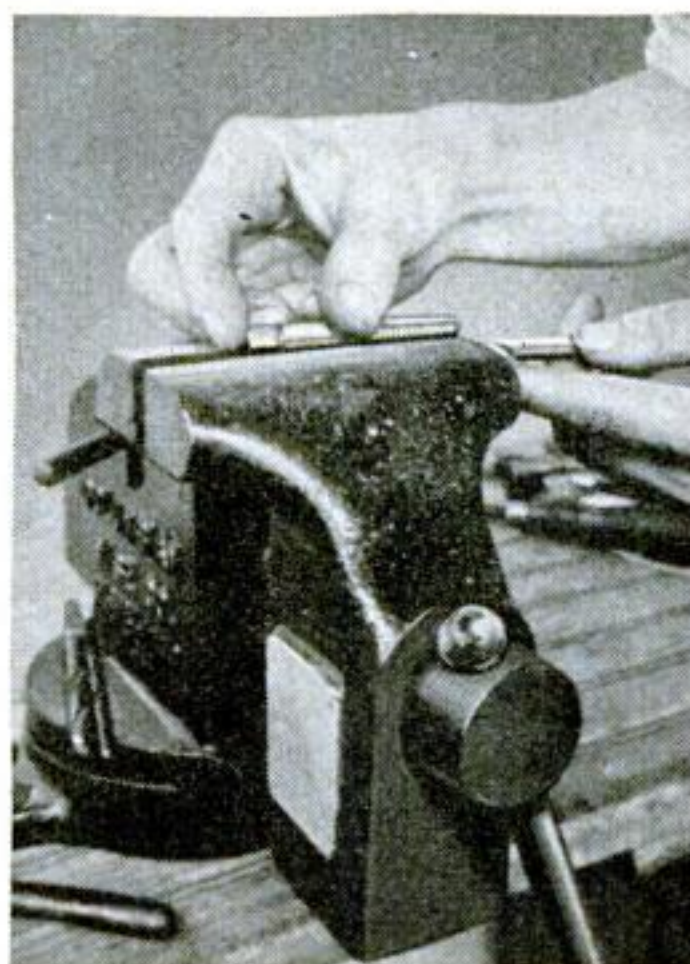
Filing Machine Moved on Rolling Platform

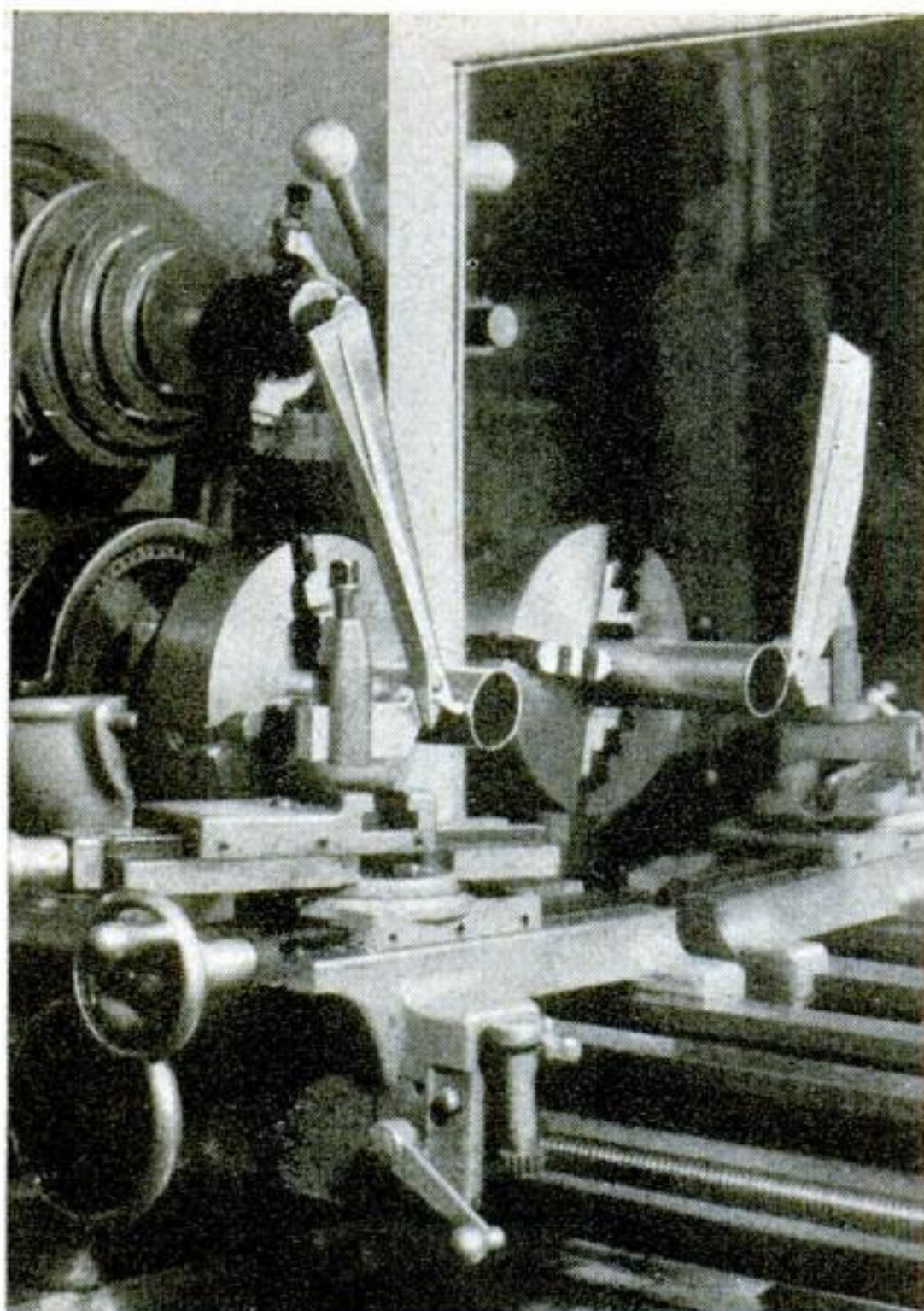
IN ONE die-making shop, the die-filing machine is mounted on casters as shown above. Instead of carrying heavy die parts to the machine, the machine is moved to the die maker's bench, and he stands on the platform while using it. Similarly, all the tools for the punch-press set-up man are carried in a small cabinet on wheels, which may be moved from press to press.—ROBERT AVARD.

Vise Jaws Serve as Gauge for Tap-Drill Sizes

WHEN no chart or tabulation is at hand giving the correct size of drill to be used with a certain size tap, the size may be found by trial, as follows:

Open the vise jaws a little less than the diameter of the tap to be used. Lay the tap carefully in the opening and move the jaws until the tap is supported only by its threads or a certain part of them. That will depend upon whether it is desired to tap full-depth threads or less than full-depth threads—75 percent threads, for example. The gap between the jaws will then indicate the drill size. All that is necessary is to select whichever drill comes closest to filling the gap.





Centering a thin tube for internal threading. Note the mirror view. Right, the construction

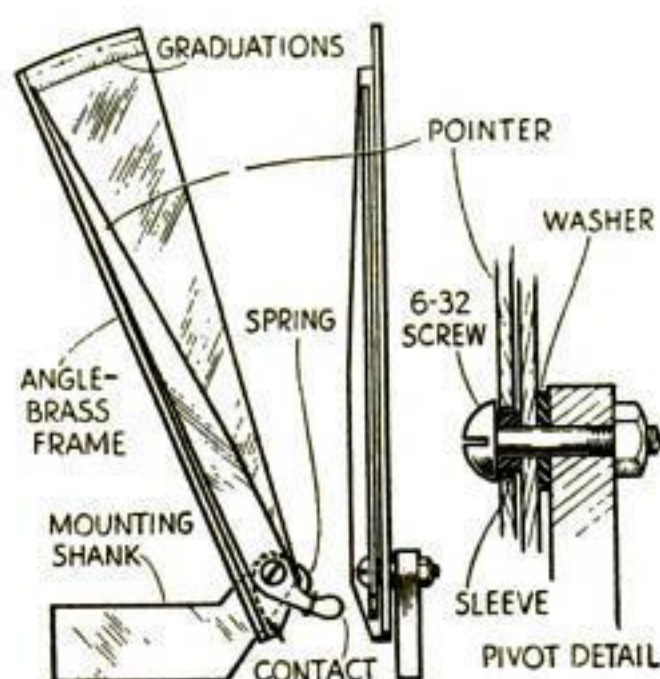
A Centering Indicator for Lathe Work

THE amateur machinist who has struggled with the problem of centering a piece of stock in a four-jaw independent chuck will find the job easy if he makes the centering device illustrated. Photograph and drawing are self-explanatory. The original is brass, but other materials, such as hardwood, hard rubber, or fiber, may be used.

The only part that needs care is the fit at the pivot of the indicator pointer and the graduations

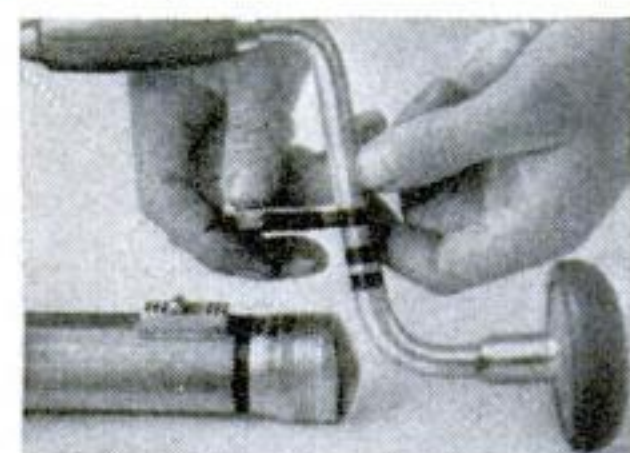
so that a reasonably accurate reading can be had. The dimensions are optional, but the greater the ratio between contact and pointer and the smaller the graduations, the closer will be the adjustment that can be made.

To use, mount the indicator as shown, bring it up to the work, rotate the work slowly by hand to the place giving the lowest reading, then back off till the pointer is at zero. Rotate to the highest reading and adjust to halfway between. Repeat the operations till the work is centered.—B. G. S.

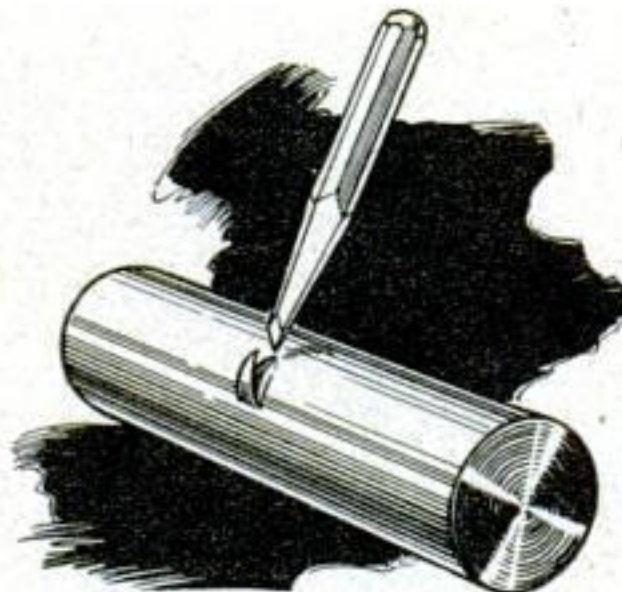


Tape Identifies Tools

WHEN several mechanics are working together and using tools of the same kind, confusion as to ownership often arises. A practical method of marking tools for instant identification is with colored cellulose wrapping tape, which can be applied to wood, metal, or any material of which tools are made.—F. B.



Cutting with an Oxyacetylene Torch



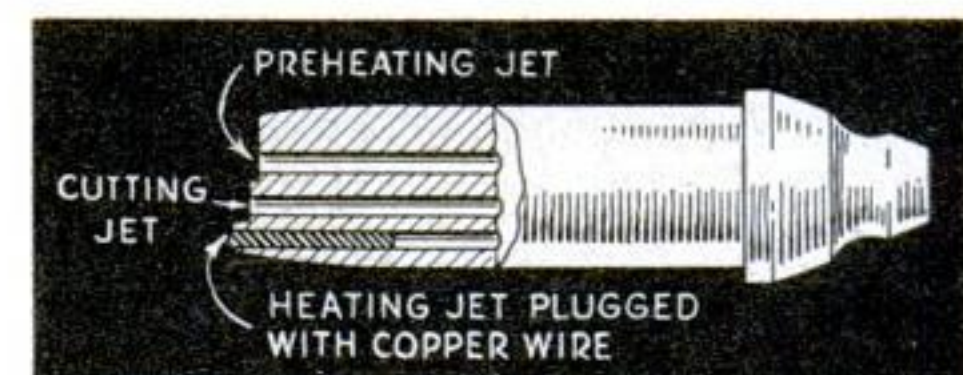
Modified tip for cutting thin sheets; a regular tip with multiple preheating jets; how shafting is cut

the cutting valve of the torch wide open. If the proper size tip and pressure are used, you will have a clean hole through the piece before you realize it. A tip with multiple preheating jets is best for this work. The torch is held at a slight angle when making holes, so as to avoid the blow-back, as it is called, from striking the head of the torch.

To burn out rivets, first cut the head of the rivet off flush with the sheet. Next, raise a spur from the center of the rivet, and if the rivet is small, hold the torch pointing directly through the center of the rivet. For punching rivets in auto and truck frames, we use a No. 2 tip having four heating jets with 60-lb. oxygen pressure.

When working with a cutting torch around automotive equipment, make sure that all the oil and grease are cleaned away from the vicinity of the cut, as oxygen blowing on oil or grease amid a shower of sparks will start an intense fire in short order. When laying the torch down, always make certain to protect the tip.—W. C. CHENEY.

This is the second in a series of short articles on oxyacetylene cutting and welding.



Broken-away view of modified cutting tip

TIPS for all oxyacetylene cutting torches have two or more preheating jets and a central oxygen cutting jet. For most average work this is satisfactory, but in cutting thin sheets it leaves ragged edges and is wasteful of gas.

For all plain cutting on sheets from 1/16 to 3/8 in. thick, we use a tip modified as shown at the right. One of the heating jets is plugged with a piece of copper wire for about 1/2 in., and the end gently peened over smooth and tight. Then a step is cut as indicated in the end of the tip. The tip will now cut only in one direction, that is, with the heating jet leading. On light cuts, the tip may rest directly on the metal

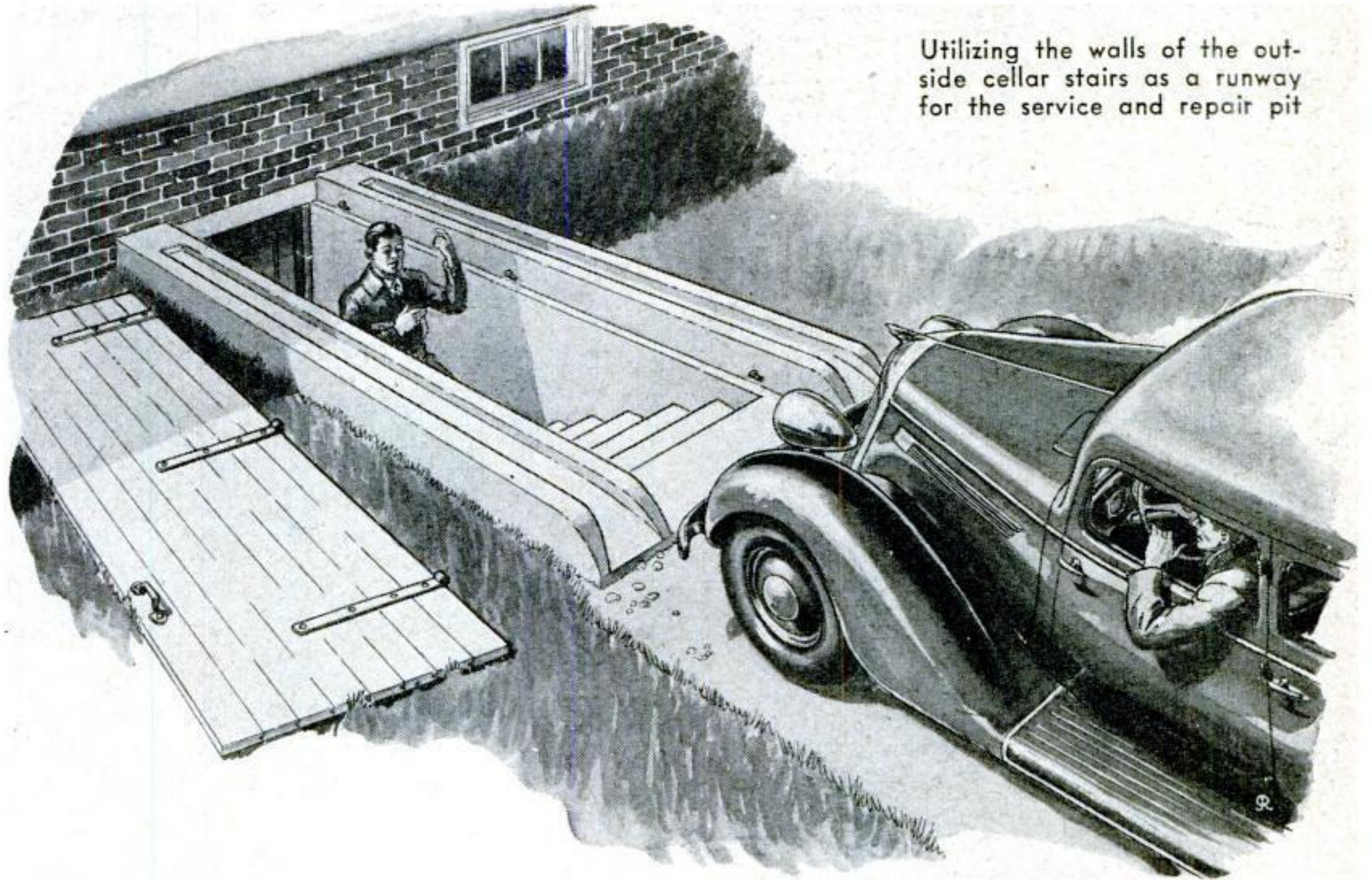
as it is pulled along. For average work on sheet stock, and with a cutting jet about 1/64 in. in diameter, we use about 20 lb. oxygen pressure.

On all ordinary cutting of flat sheets, one usually has an edge from which to start the cut, and the sharp corner is easily raised to the required temperature by the preheating jet. That is not the case, however, with a smooth, curved surface like a piece of shafting or a rivet head, or if it is necessary to punch a hole in a piece of plate.

Simply take a sharp diamond-point or round-nose chisel and cut out a spur of metal about 1/4 in. long. Hold the torch at a slight angle, heat the spur until it begins to spark, and then shove

Timely Aids for Motorists

WHEN building a new home or remodeling an old one, an outside cellar door can be constructed to serve as a convenient automobile repair pit. The concrete side walls of the stairway should be built so that their top surfaces can act as runways, leveling off at the ground to form a ramp for the car wheels. After the car has been driven up on the runways, the underside of the chassis can be reached for greasing or necessary repair work by means of the door leading out of the cellar of the house. In the drawing reproduced at the right, the cellar door is mounted on the side walls by special hinges so that it may be quickly and easily removed when the space below is needed for repairing or greasing a car.—A.H.W.

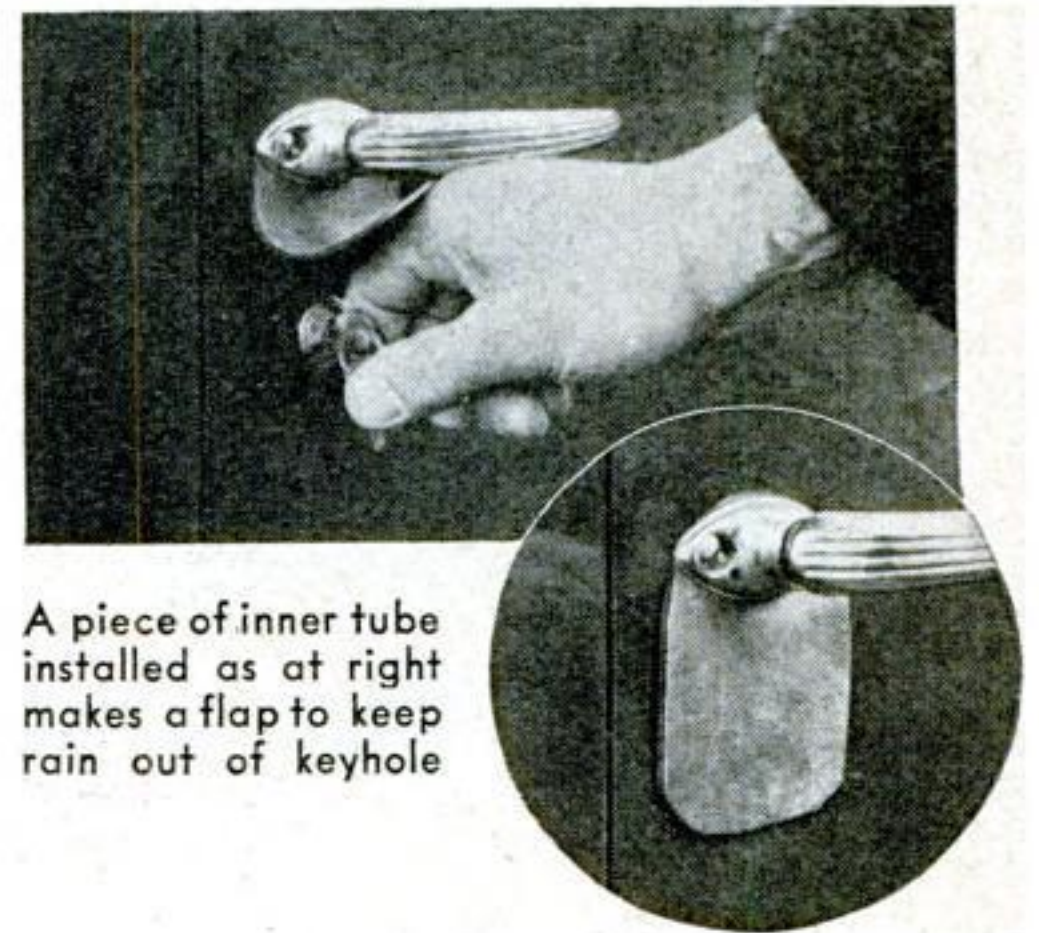


Utilizing the walls of the outside cellar stairs as a runway for the service and repair pit



Gas-Can Chain Cuts Danger from Sparks

SERIOUS explosions and fires have occurred when a spark of static electricity ignited gasoline while it was being poured from a can into an automobile tank. To prevent this, it is a good idea to fasten a chain to the can nozzle so that it hangs down and makes contact with the car tank. Even when gas is being pumped through a service-station hose, it is well to be sure that the metal hose nozzle touches the metal of the tank, as a safety precaution against static sparks that might ignite the gasoline.—W.C.C.



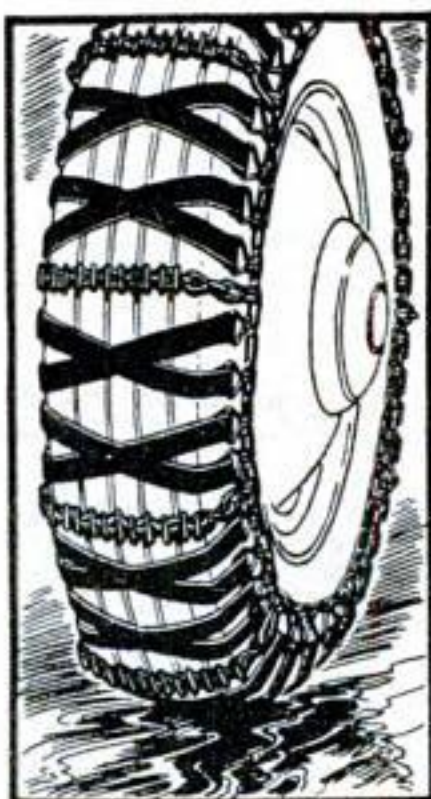
A piece of inner tube installed as at right makes a flap to keep rain out of keyhole

Flap Ends Frozen Locks

TO KEEP door locks from freezing when a sudden cold snap follows a rainy spell, loosen the door-handle screws and place a strip of inner tube around the shaft so that it hangs down to protect the keyhole.—W. E. W.

Combination Chains Do Double Duty

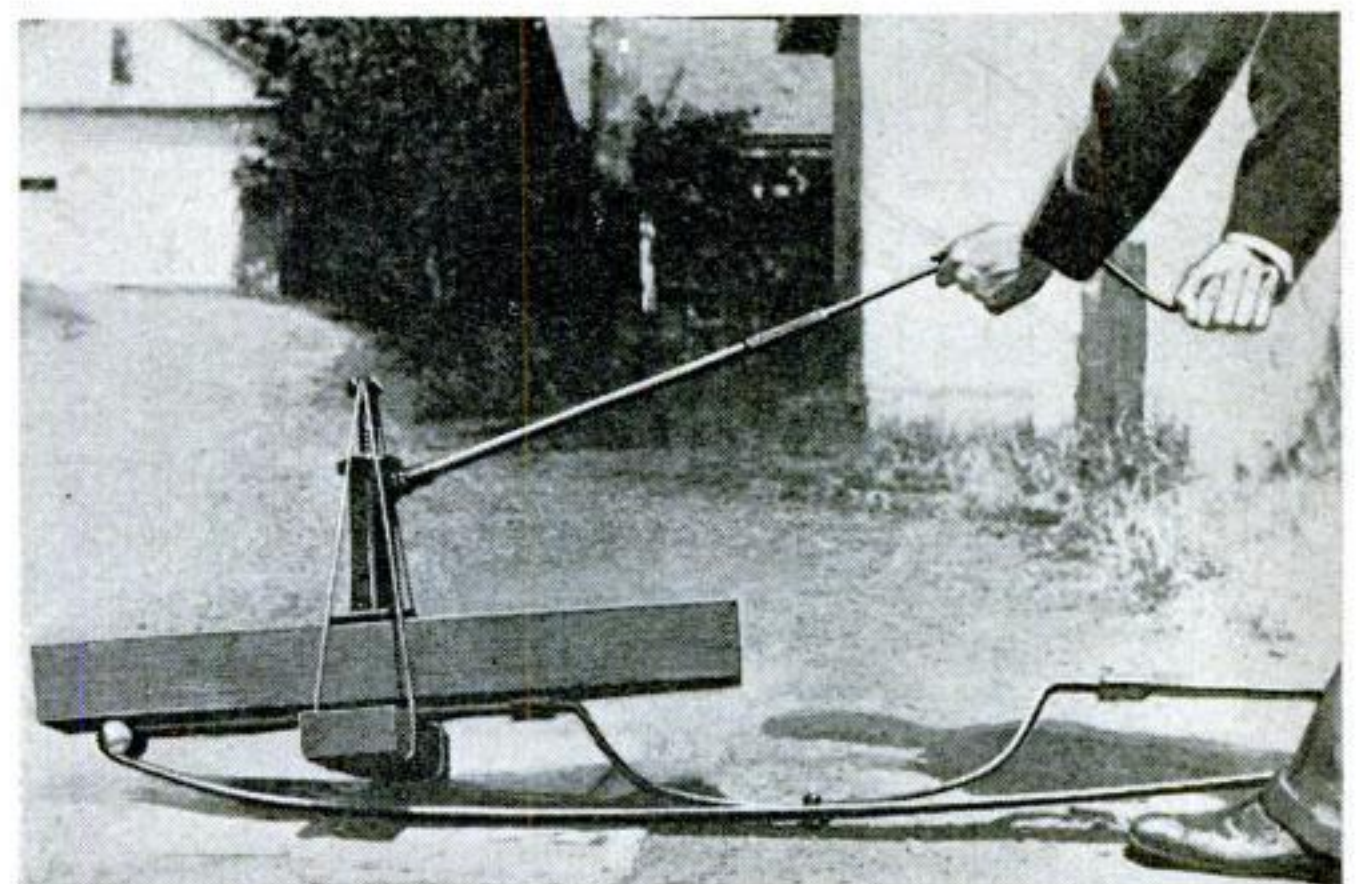
RUBBER and steel cross links can be combined to form a heavy-duty tire chain that provides excellent traction on ice and in heavy snow and has exceptional wearing qualities on city streets and portions of highways that are worn clear. To a set of rubber chains having X-type cross links, conventional welded-steel cross links are added at spaced intervals, as shown above.—A.C.R.



How the two types of links are combined

Car Jack Straightens Bent Bumper Bars

A BENT bumper bar can be straightened easily by using an automobile jack in combination with a loop of heavy wire and two pieces of strong wood. One piece of wood is placed below the bar, and the other above, with the jack on the latter and the wire looped from the top of the jack under the lower section of wood, as pictured at the right.—P. W. S.



Operating the jack applies the force to straighten the bumper

Birth of a VOLCANO

SHOWN IN YOUR LIVING ROOM



MINIATURE VESUVIUS. Powdered soap fed down from the funnel into the chimney of the "volcano" is blown upward by air pressure and falls on the disk to form a realistic crater

By GAYLORD JOHNSON

ASK ten men on the street where the lava that spouts from volcanoes comes from, and probably nine of them will say that the interior of the earth is a fiery mass of molten rock and that it occasionally escapes by erupting through volcanoes.

For years, this was a generally accepted view, but now modern geologists have advanced a new theory. Volcanic lava, they say, is produced comparatively near the earth's surface by the wrinkling of the rock crust as the giant

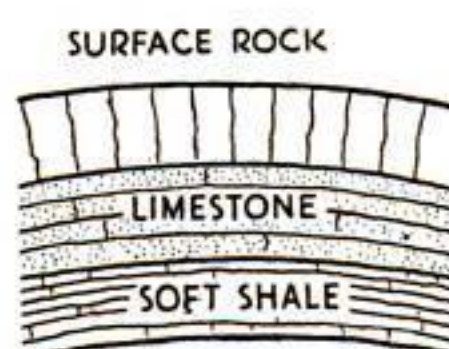
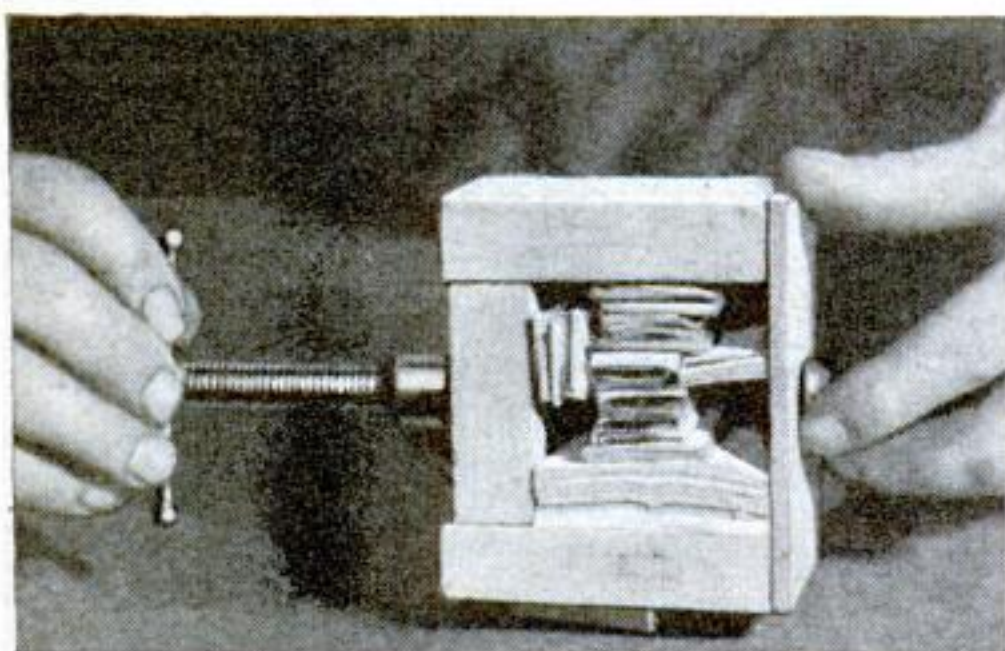
globe contracts. By performing a few simple experiments, you can demonstrate this theory and see how the shrinking earth throws up the ridges that form mountains and how this puckering is indirectly responsible for volcanic eruptions.

To see how the mountains were formed, take an ordinary five-cent toy balloon, and inflate it. Tie the neck tightly, using a knot that can be untied easily. Then paint upon this globe the shapes of some of the continents—North and South America, let us say.

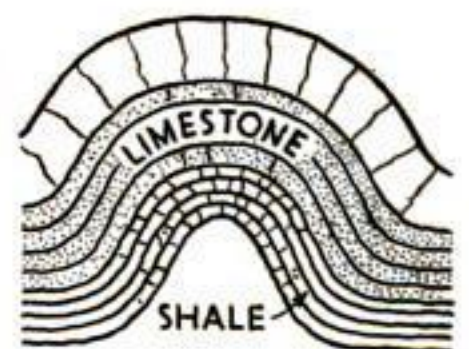
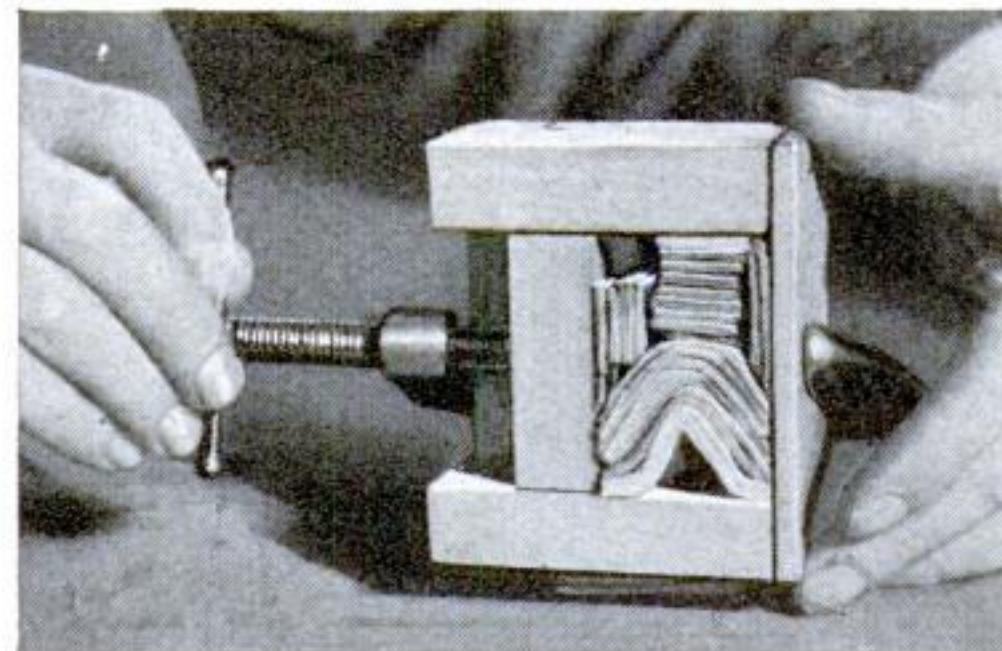
The substance you use to paint with is important. It must be a liquid that will go evenly with a water-color brush or camel's hair "pencil." It must also dry quickly. Shellac will do this quite well, but I have had the best results with a commercial cement for mending china. When the bottle is warmed in hot water, the cement becomes liquid enough to paint on easily, and in a few minutes it cools, stiffens, and remains plastic.

The thin skin of cement applied to the balloon represents the layer of sedimen-

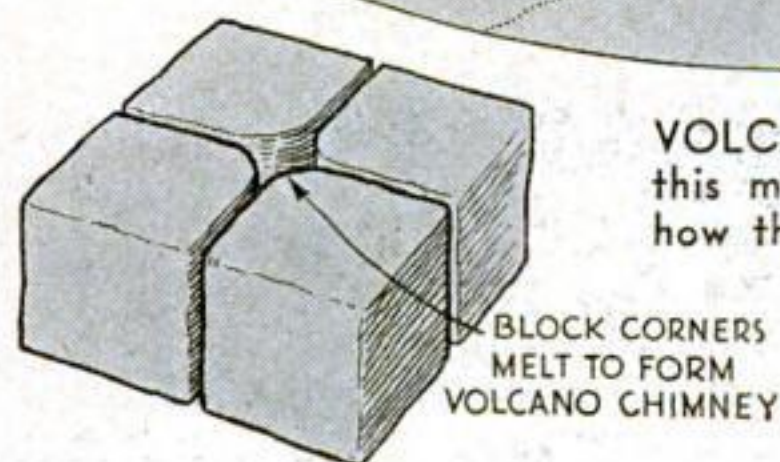
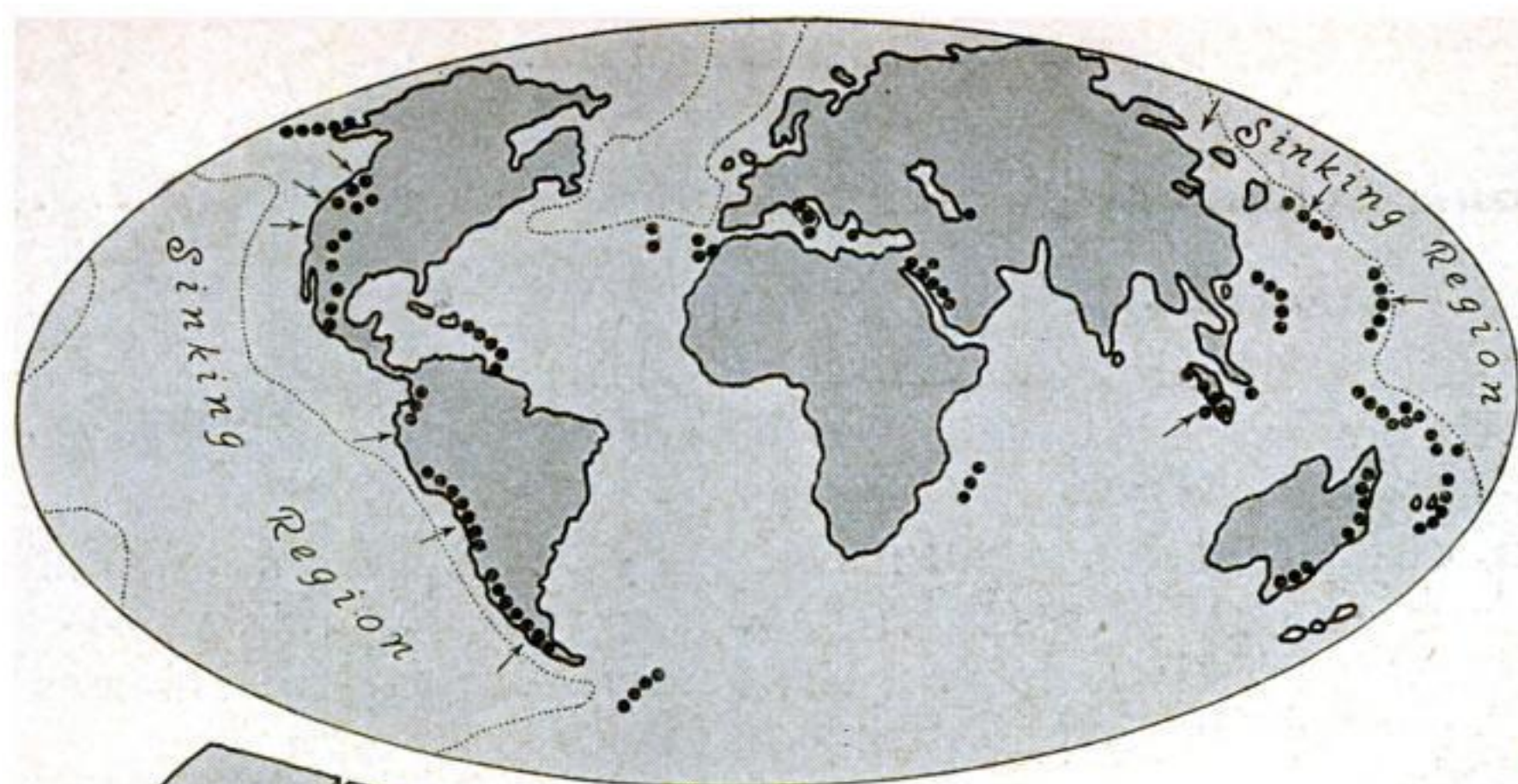
YOU CAN DEMONSTRATE HOW CRUSHING OF ROCK LAYERS PRODUCES



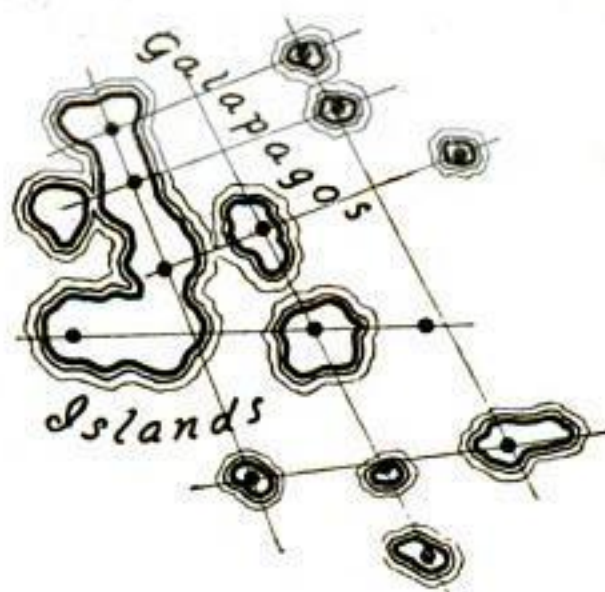
In the apparatus at the left, cardboard represents the hard limestone, blotting paper the soft shale



As pressure is applied, the cardboard is bent into an arch while the blotting paper yields easily



VOLCANOES HUG SEACOASTS, as shown by this map. Drawings at left and below illustrate how they occur along cracks in the surface rock



tary surface rocks which forms the continents. The inflated rubber balloon is the center of the earth, which underlies both continents and sea bottoms.

Now we are ready for the slow, age-long shrinking of the earth's core to begin, and for the mountains to rise.

To start this action, pinch the neck of the balloon tightly while some one else unties the string. Then allow some of the air to escape, very slowly. As it does, you will see an amazing sight. As the ball grows smaller, the continental "rocks" are being gradually wrinkled into quite realistic little mountain chains. As shown in the photographs, you will even note that rows of mountains tend to form parallel to the shore lines, just as the backbone of the Americas actually does along the Pacific coast. This simple experiment shows clearly that the world's mountains are merely puckered ridges like those in the loosened skin of a shrinking peach! It has, in fact, been calculated that a decrease of 200 miles in the earth's diameter would account for all its mountains.

But why do volcanoes, erupting hot melted rock, form among these puckered ridges, particularly in the ridges being pushed up near seacoasts? That they are produced along the coasts is a fact, for ninety percent of the world's great volcanoes are within sight of the sea.

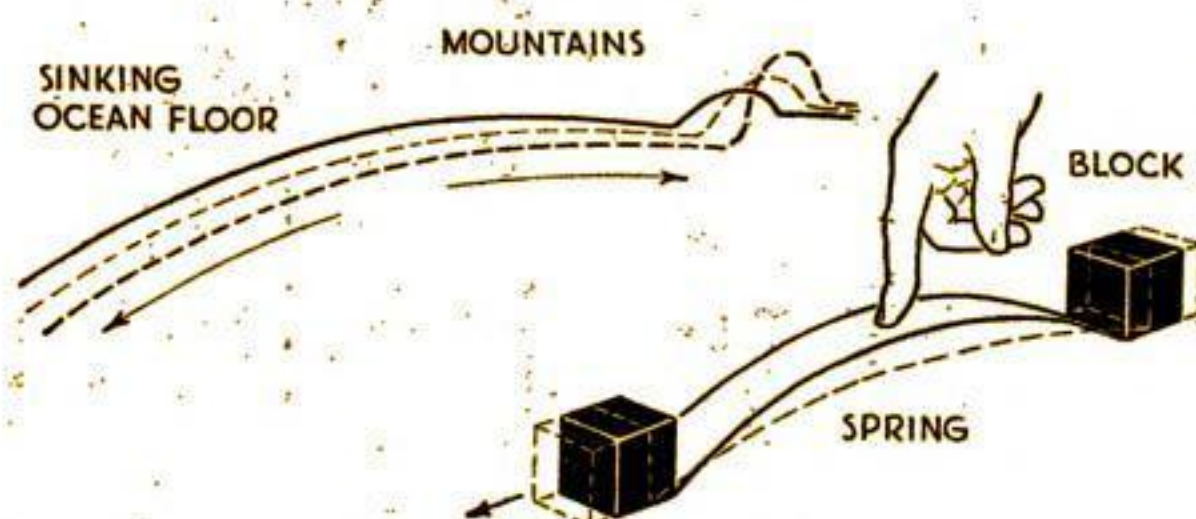
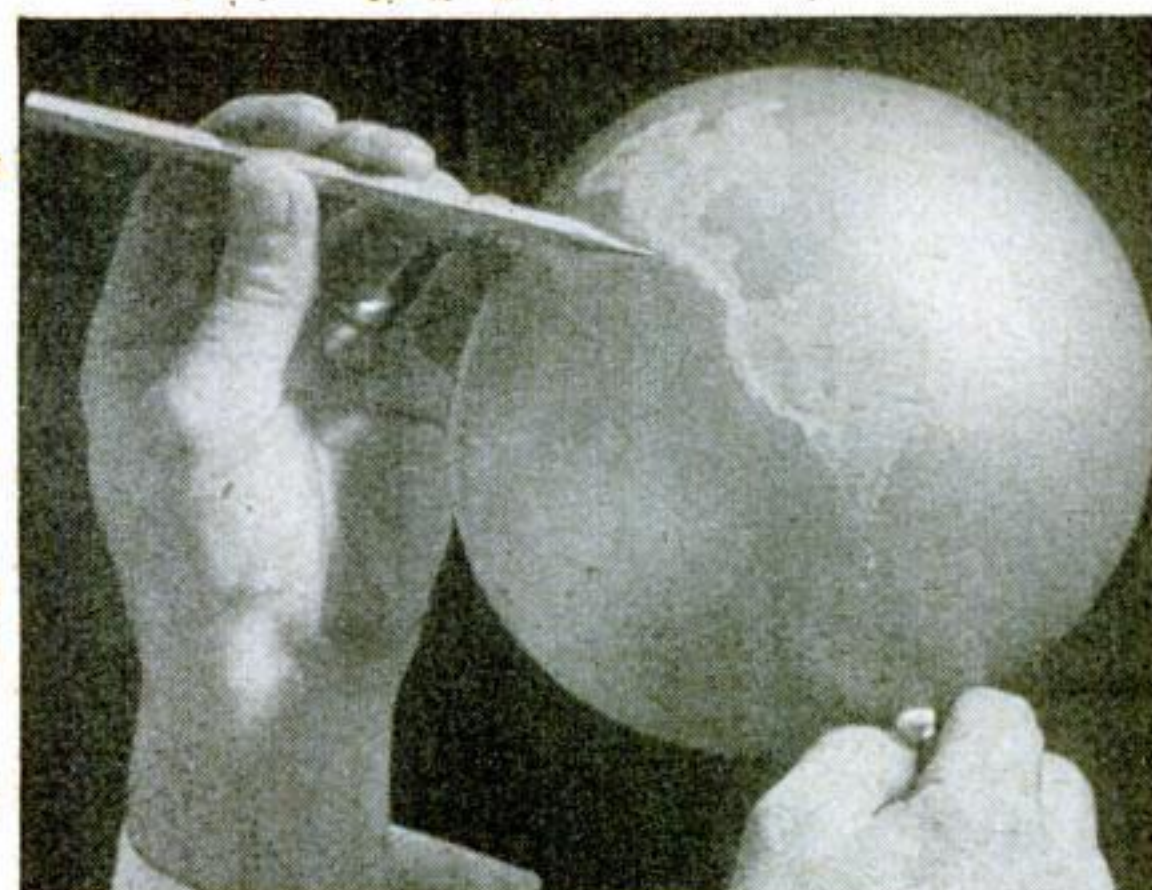
With the aid of another simple experiment, let us see how a pocket of melted volcanic lava is created deep within the puckered rocky ridge of a rising mountain.

The experimental apparatus consists of a pile of small pieces of stiff cardboard and soft blotting paper, crushed from the side in a strong box by the screw of an iron clamp.

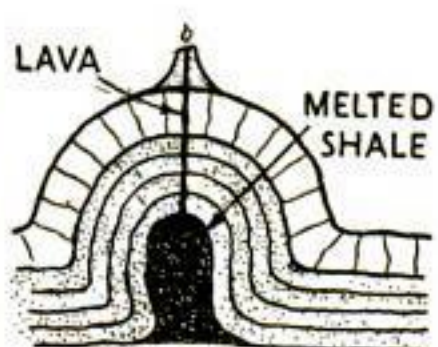
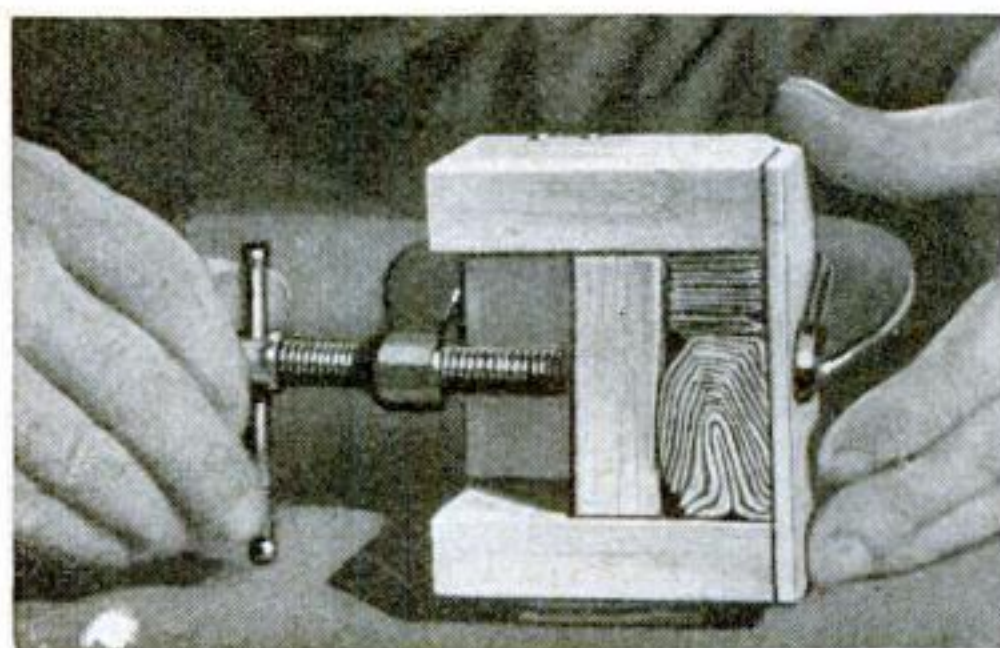
The pieces of stiff cardboard on top represent strata of hard limestone rock, and the blotters underlying strata of softer shale. Both kinds of rock were formed in layers of sediment, at the bottoms of prehistoric seas. And now both are buried under miles of heavy, overlying fractured rocks, represented by the irregular bits of cardboard in the apparatus illustrated.

As we tighten the screw, we are reproducing the sidewise pressure which the shrinking sea bottom exerts upon the puckered-up skin of the continental rocks near the coast. The diagram explaining our balloon experiment shows how this happens in the natural mountain-building process.

As the pressure increases, the stiffer cardboard above is bent upward into an arch under which the blotting paper

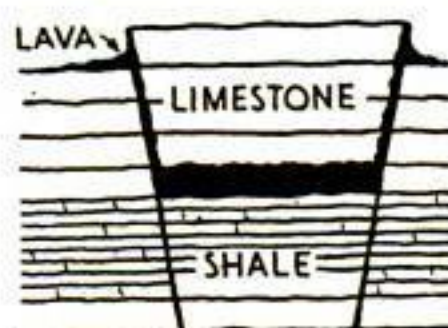


Liquid cement painted on a toy balloon to represent continents, wrinkles at the edges as air is let out. Diagrams show how shrinking causes sidewise pressure



Finally, the arch of cardboard cracks at the top. The blotting paper is crushed together in its center

Sometimes a block of crust is pushed upward, allowing the lava to flow out



is mashed together, just as the softer shale rocks of the earth's crust are crushed together to fill the dome-shaped cavities made from them by the wrinkling of the more rigid limestone.

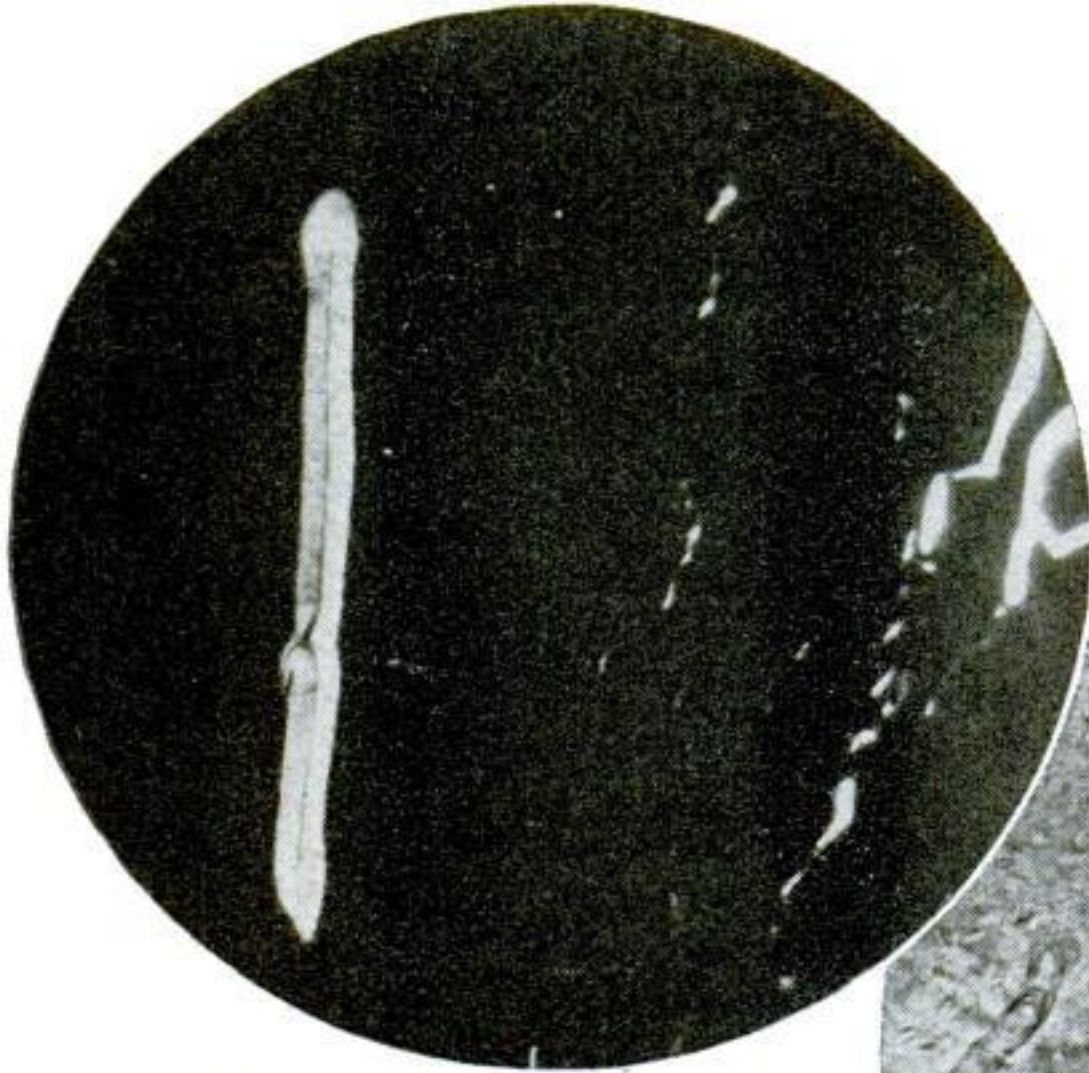
It must be remembered that the temperature increases rapidly as you go downward into the earth's crust. At a depth of several miles, the heat is almost great enough to melt shale. The only thing that keeps it solid is the enormous pressure upon it from above. When this pressure is lifted off by the arch of limestone formed above the shale, and when the considerable heat caused by crushing is added, the soft shale *does* melt. As a result, we have a pocket of melted lava formed in the center of the puckered-up fold of crust!

How heat is produced by crushing can be shown by punching a small hole into the center of a sponge-rubber ball and inserting a small thermometer bulb and tube. Tie a thread around the tube to mark the level of the mercury. Now roll the ball on a table top, under heavy pressure from a board or book. After about five minutes of kneading, the thermometer will show a rise of ten degrees or (Continued on page 130)

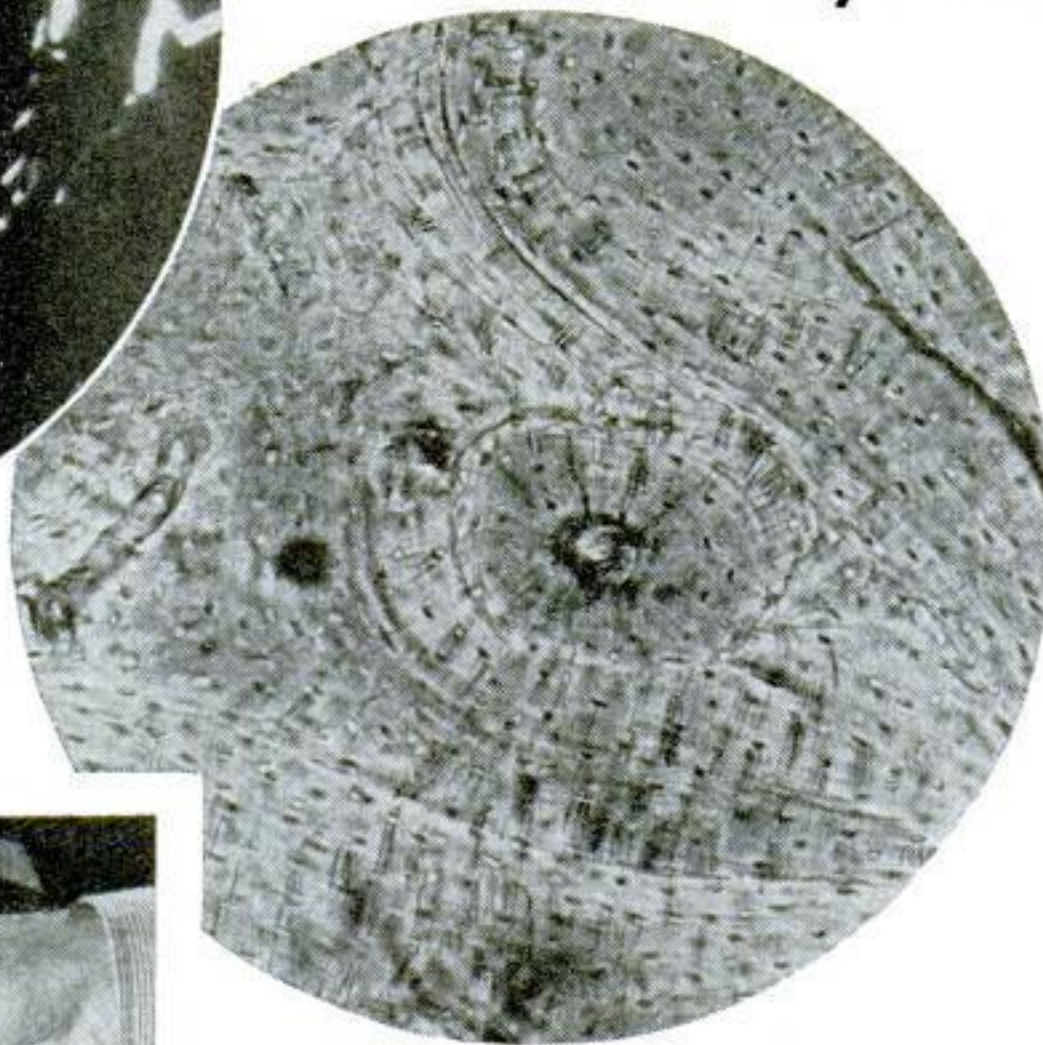
Seeing Through Coal

This Article Tells You How To Prepare Specimens of Rock, Bones, and Minerals, Using the Very Same Methods That Are Employed by Research Workers in Large Laboratories

By MORTON C. WALLING



A flattened spore of a prehistoric plant, seen in coal. Right, cross section of a bone



It happens that practically the same steps are followed in preparing a considerable number of different kinds of hard materials to make them translucent enough to examine. Such materials include coal, bone, sea shells, teeth, fossils, peach stones and similar dense seeds, foraminifers, and coral. In fact, it is a relatively easy matter to prepare thin sections of any hard substance, except those that are made up largely of silica, with the aid of a few inexpensive tools.

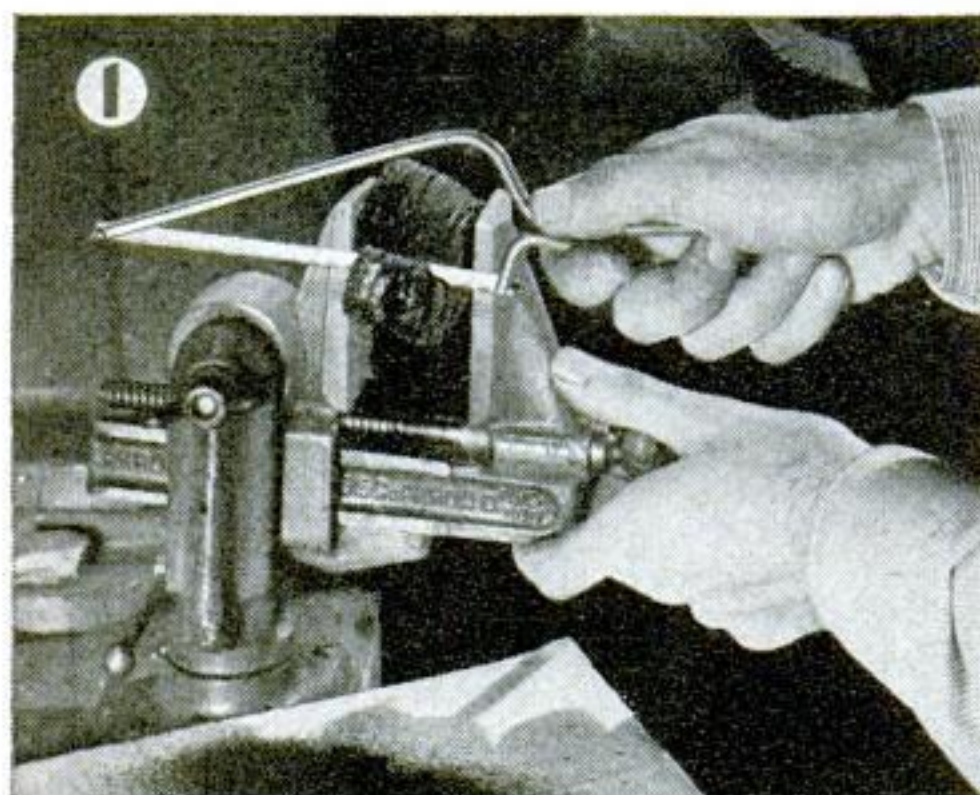
Although the process of making thin sections of hard materials will be described with no specific substance in mind, you will find ordinary coal convenient to use until you have acquired some skill. Coal is easy to obtain, simple to work, and contains a surprising number of microscopic details unsuspected by some persons. Another easy substance to work is bone, such as that from beef.

In making thin sections, the first step is to obtain a flat surface. With coal, bone, and the like, this is done by slicing the specimen in the direction in which the section is to be made. That is, if you want a cross section of a bone, cut it crosswise. A thin-bladed metal saw, such as a small hack saw, can be used for bone, coal, fruit seeds, and so on. For harder objects such as teeth, a metal disk charged with diamond dust or some other abrasive is better, but usually is not available to the average amateur microscopist. Perhaps you can find a local gem worker, jeweler, or optician, who will do the cutting for you.

After the cut has been made, it is necessary to make the surface of the

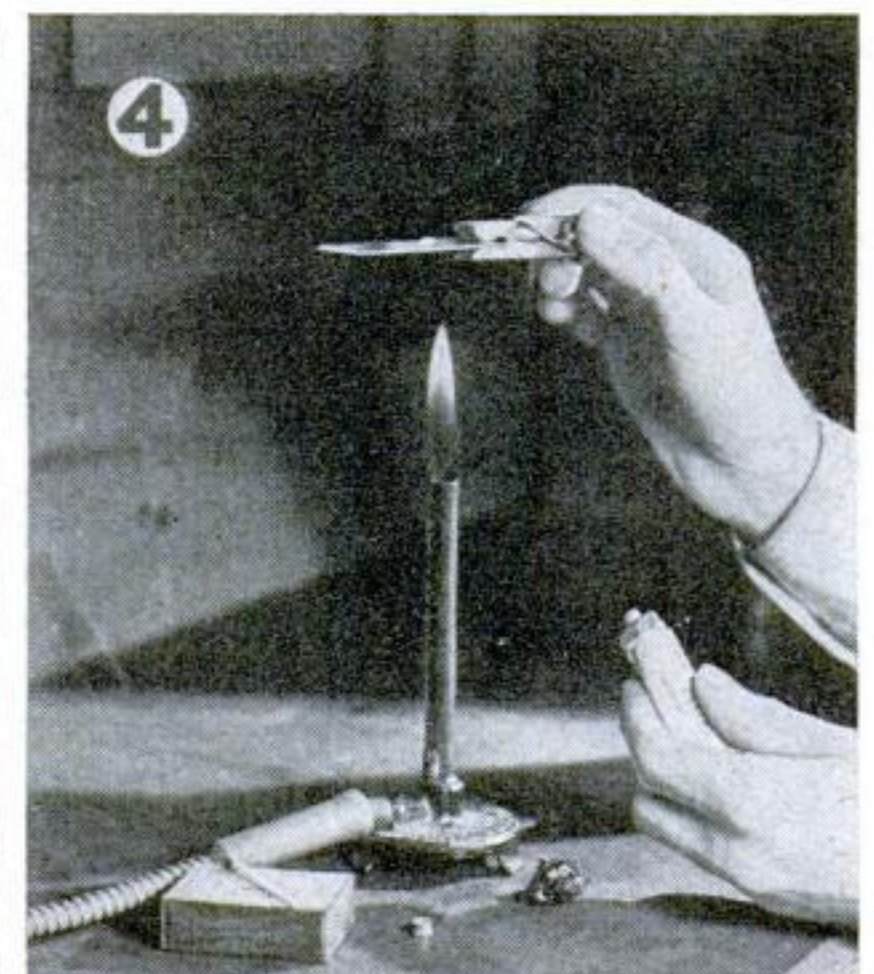
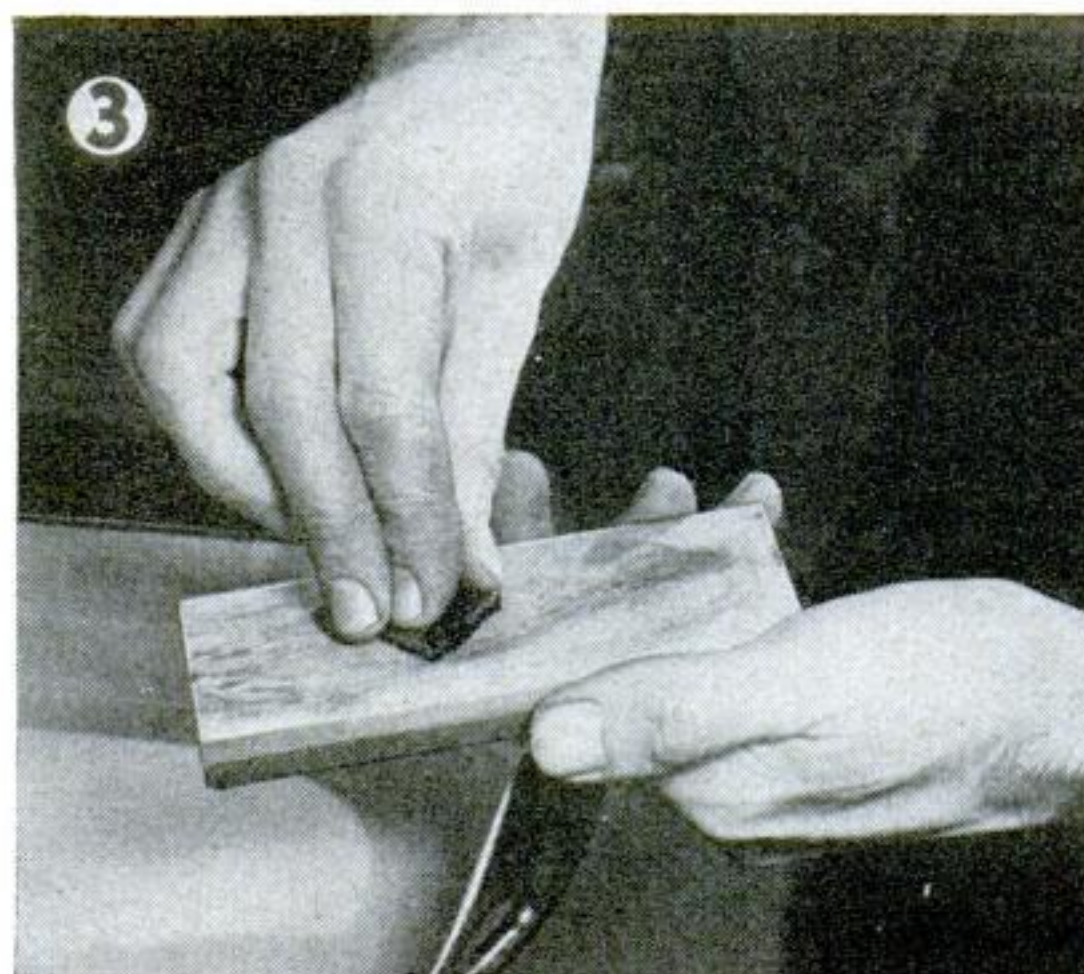
TO THE average person, the idea of passing light through a piece of coal sounds like magic or pure hokum. Tell him that coal isn't always black, but sometimes red or yellow, and he will stare at you incredulously. But the microscopist, whether amateur or professional, knows that there is hardly such a thing as an absolutely opaque substance, and that many common objects reveal unsuspected qualities when viewed under the magic lenses. With your own instrument you can look through coal, and also through bones, rocks, and sea shells.

The secret of seeing through normally opaque, hard materials lies in the process of preparing them for the microscope. This consists essentially of slicing them into sections thinner than the finest tissue paper.



HOW A SLICE OF COAL IS MOUNTED FOR MICROSCOPIC EXAMINATION

- 1 With a small hack saw, cut a piece from a chunk of coal to make a flat surface
- 2 Grind the cut surface smooth on an abrasive stone that is immersed in water
- 3 Or, if you prefer, you can saw off the slice before polishing either surface
- 4 Warm some balsam on a slide to harden it for cementing the coal to the glass
- 5 Grind down the mounted slice and finish on a cloth pad charged with metal polish



with Your Microscope

part to be used as flat as possible. You can do this by rubbing it back and forth on a rough abrasive stone lubricated with water. A stone of a texture about like that of an old-fashioned grindstone will do. In Government and other laboratories where many such sections are worked, horizontal, power-driven grinding wheels, operating in a stream of water, are employed.

After the first grinding to level off the surface, change to a finer-grained stone, and rub until the grooves made by the first stone are removed. You generally can obtain suitable stones from the ten-cent store. Use water as a lubricant.

Continue the polishing operation on a razor hone lubricated with water. At little cost you can obtain fine-textured razor hones that will put a high polish on most specimens. Sometimes two-surface stones are available, one surface being moderately fine-grained and the other extremely so.

It may be that no polishing other than that on the fine-grained razor hone will be necessary. But if there still are fine scratches in the surface, further polishing on a cloth pad charged with some abrasive material will be desirable. Some laboratories have found that certain prepared silver polishes work satisfactorily as final polishing agents for coal and the like.

When the first surface is finished, it is necessary to arrange the specimen so that it can be held while the second surface is polished, and the thickness reduced to the desired degree. It is possible, with most specimens, to use the saw again, and cut off a thin slice from the polished end of the piece. Sometimes this slice can be worked down by holding with the fingers while it is pressed against the stones. When the specimen becomes very thin, use a piece of cork or rubber to hold it while you are rubbing it back and forth.

However, since this method can be used only with such tough articles as bones, and then not always with success, it is best to cement the specimen to a glass support. A piece of thin plate

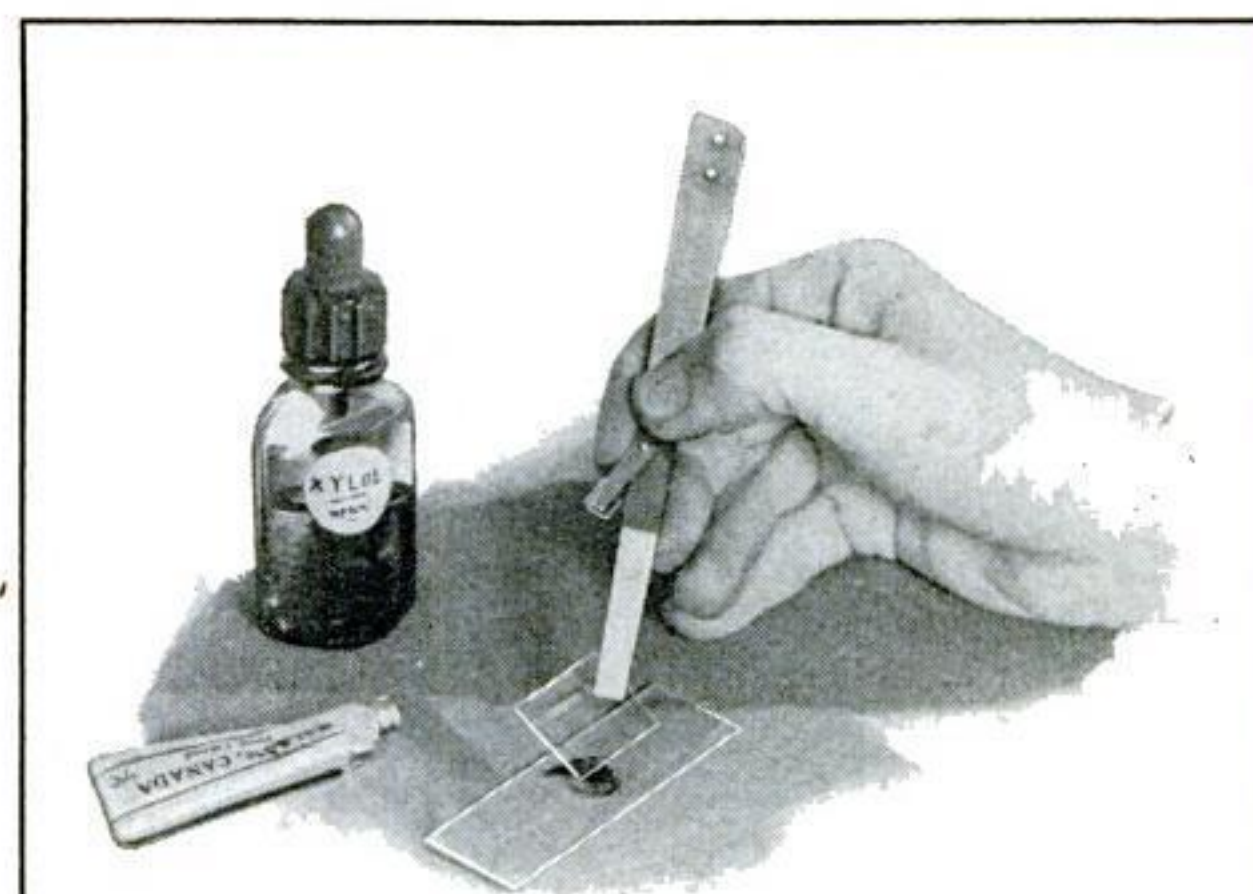
With your microscope you can unearth secrets of nature in fossils, bones, and minerals



glass, or a standard one by three-inch microscope slide, will do. The cement can be Canada balsam, marine cement, or a mixture of the two. For most purposes, the balsam will work excellently. Place a drop or two of it in the center of the glass and warm it gently over a flame. This drives out some of the solvent and causes the balsam to thicken. Do not heat enough to cause bubbling. After a time, let the slide cool, and test the balsam with your finger nail. If you can dent it easily, heat some more; if the balsam is brittle and easily cracked when cold, you have heated too much, and must add some unheated balsam and warm again.

After the balsam is found to be just right, warm it until it becomes tacky, and press the polished side of the specimen against it. It is best to bring one edge of the specimen in contact with the balsam surface first, and then gradually lower it so that air imprisoned underneath it is carried across and out the other side. Let the slide cool.

Rough grinding is done on the second surface exactly as on the first. Be careful not to carry the operation too far, or you will reduce the thickness (Continued on page 127)

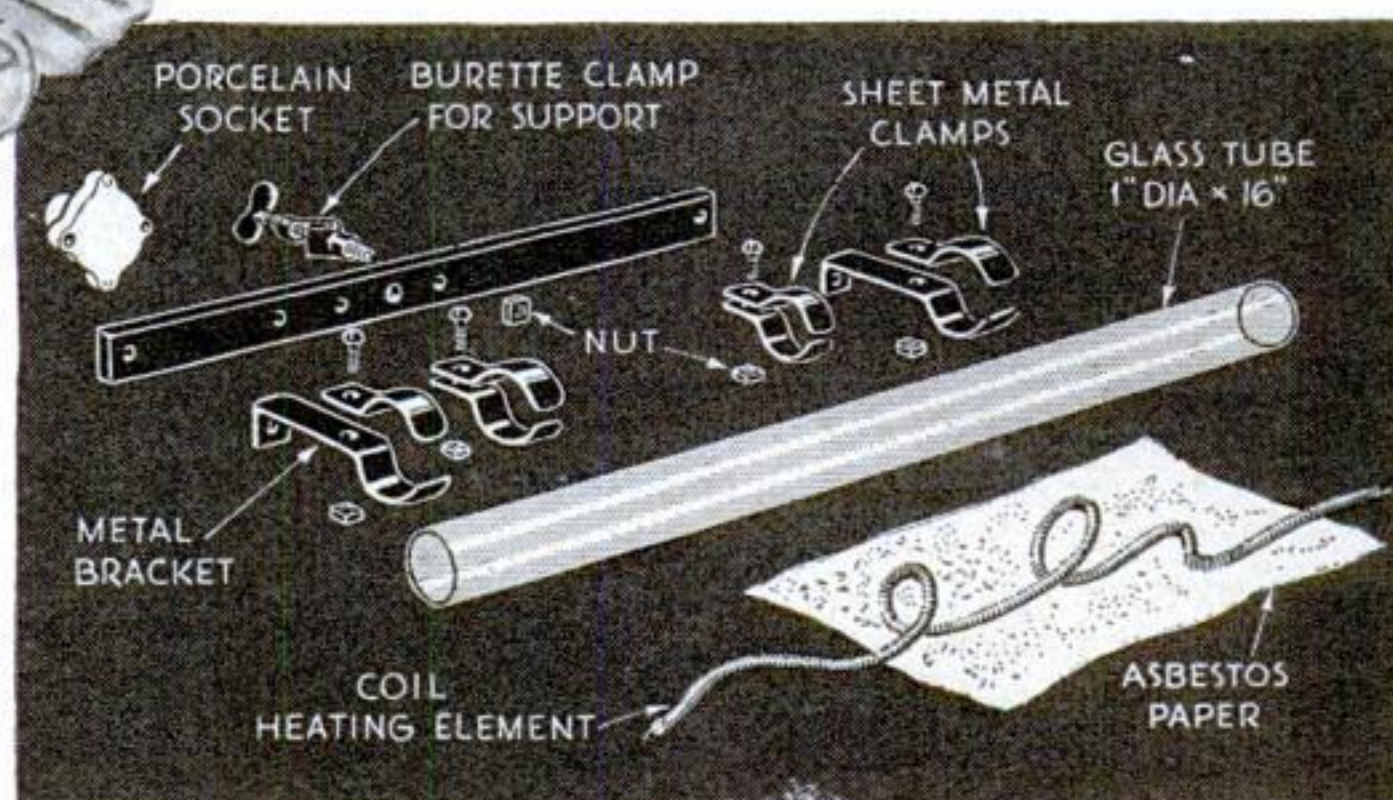


Make Your Own Tweezers

IF YOU have trouble finding suitable tweezers for microscope work, you can easily make your own. Obtain some strips of bronze, spring brass, or stainless steel, and cut two pieces of the shape desired. After bending them so that they curve slightly, place them together with the concave sides next to each other, and rivet or solder the handle ends. You will find it worth while to make several shapes. A good selection includes a pair of the needle-pointed kind, preferably made of stainless steel; heavy, round-nosed ones for rough work; and a pair of "duckbills" with thin, flattened tips.



For a Few Cents You Can Experiment with GOLD



With this homemade electric combustion furnace you can demonstrate how alcohol is converted into acetic acid

HOME experiments with costly gold and platinum, and with another rare metal called cerium, need not strain an amateur chemist's pocketbook. Quite possibly you may find all three in your own home! If not, you can easily obtain enough of them for your laboratory tests at surprisingly small cost.

Gold is a "noble" metal, reluctant to mix or combine with the commoner elements such as oxygen. In contrast with metals like iron, copper, and nickel, it refuses to dissolve in most acids. This so impressed early alchemists that they gave the name of aqua regia, or "royal water," to one mixture of acids which does dissolve gold. You can make aqua regia just as they did—by mixing about three parts of hydrochloric or muriatic acid with one part of nitric acid, the parts being measured by volume. Since the mixture of acids does not keep, it should be made up freshly before use. If you can obtain a piece of discarded gold jewelry, you can dissolve a fragment of it in aqua regia for your tests.

As an alternative, you can buy some gold chloride, which comes in the form of red crystals, or a supply of a double compound known as gold sodium chloride, which is yellow. Small amounts of these compounds can be obtained for less than a dollar from a chemical supply house. Dealers in photographic supplies also can supply chemicals containing gold, which are used in toning or coloring photographs.

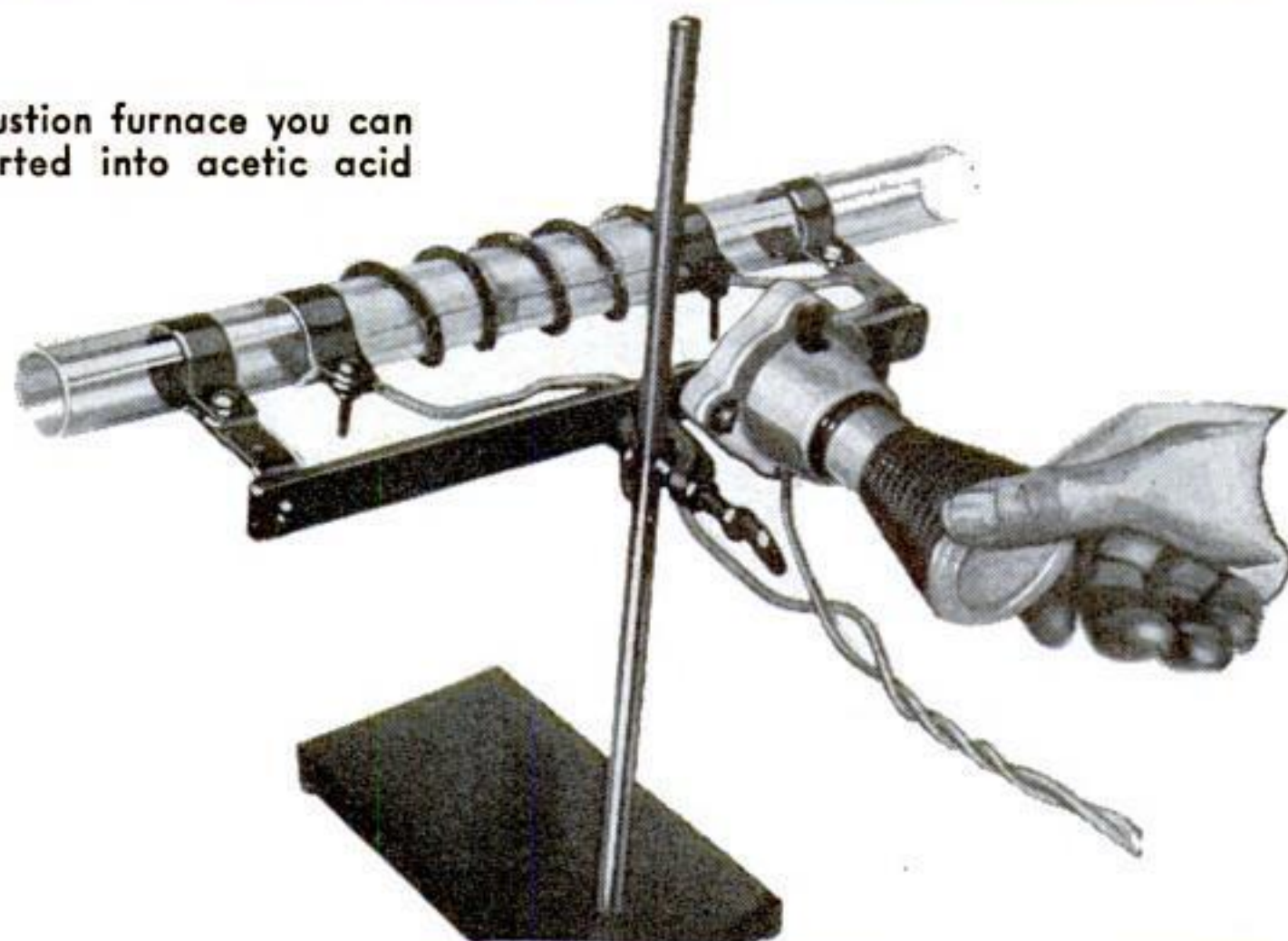
Making colloidal gold, a form in which the metal consists of extremely finely divided particles suspended in a liquid, offers an interesting home experiment. If you start with a fragment

from a piece of gold jewelry, the first step is to dissolve it in aqua regia. You will have to apply heat to do this. Continue heating, after the metal has dissolved, until the solution is evaporated to dryness—applying the heat very gently as the last of the liquid is driven off. Dissolve the solid residue in a little water, and you will have a solution of gold, together with other metals—notably copper—as impurities.

The next step is to purify the gold. Filter the liquid, and then add to it five or ten cubic centimeters of formaldehyde solution—the ordinary kind used as a household fumigant. A golden-yellow precipitate of pure metallic gold will be thrown down. Collect it by filtering the liquid, and wash the precipitate while it is still on the filter paper. This is done by squirting a stream of water over it from your wash bottle until the filter paper no longer appears discolored, showing that all soluble metallic impurities have been washed out.

Now punch a hole in the bottom of the filter paper and wash the purified gold into a small, empty beaker. Add fresh aqua regia, evaporate just to dryness as before, and dissolve the residue in about ten cubic centimeters of water. This will give you a fairly pure solution of gold, in the form of a compound closely related to gold chloride and known as chlorauric acid.

To make "colloidal gold," take about



Resistance	Size	Heat
ELECTRIC LIGHT BULB	60 TO 100 WATTS	WARM
	100 TO 300 WATTS	VERY WARM
HEATING ELEMENT	500 TO 600 WATTS	MODERATE HEAT
	1000 WATTS	HOT
FUSE	10 TO 15 AMPS	VERY HOT

Heat of the furnace is regulated by screwing resistance units into a socket connected in series with the heating circuit

one or two cubic centimeters of the solution you have just prepared and neutralize it carefully with sodium carbonate solution, using litmus paper as an indicator to show when its acidity has just been counterbalanced by the addition of the alkaline sodium carbonate. Neither blue nor red litmus paper should change color when dipped in the neutralized solution. Dilute the resulting mixture with about 100 cubic centimeters of water, and add several drops of a solution of tannic acid. Now warm

the liquid, and colloidal gold will be formed. A liquid containing gold in this form takes on strange tints, depending upon the conditions producing it. Your solution may appear blue when viewed by light shining through it, and golden-yellow by reflected light. This is due to the extremely small solid particles of gold suspended in the liquid. You cannot filter them out, as they are so small that they will readily pass through filter paper. They will stay suspended in the solution for a remarkable length of time, often for many years.

Try placing a bright electric lamp near the solution, and hold a card pierced with a small hole between the lamp and the vessel. The path of the resulting light beam through the solution will be plainly visible, since the minute particles of gold reflect the light.

If you make colloidal gold from gold chloride, or from the double chemical, gold sodium chloride, you will not need to use aqua regia. These chemicals will dissolve in plain water. The acidity of the solution that you obtain, in either case, should be neutralized with a pinch of sodium carbonate or a few drops of sodium carbonate solution. Too much acidity will prevent the formation of colloidal gold, as you can show by adding a little acid to a part of the blue solution previously made. The gold will be precipitated as a yellow powder, and the blue color of the solution will disappear. An excess of sodium carbonate should be avoided in neutralizing the

solution, as this too will destroy the desired effect.

The "flints" in pocket cigarette lighters of the sparking kind contain another uncommon metal for your experiments. Their name is really a misnomer, for the little black rods actually consist of an alloy of about seventy percent of cerium metal and thirty percent of iron. If particles of this particular alloy are torn off with a file, they take fire in the air, and the same thing happens when a flick of your thumb rotates the knurled wheel of the pocket lighter against the flint. Other applications of this unfamiliar metal, cerium, include its use in Welsbach mantles for gas lights, and in certain medicines such as remedies for seasickness.

Cerium obtained from a lighter flint will enable you to demonstrate an exception to the general rule that chemicals dissolve more readily in hot water than in cold water. The compound with this unusual behavior is cerium sulphate. To prepare it, dissolve one of the flints in a mixture of five cubic centimeters of water and the same amount of strong sulphuric acid. The little rod will entirely disappear.

The solution now contains cerium sulphate and iron sulphate, which are easily separated. Warm the liquid gently, and, if necessary, continue heating it, until pinkish crystals of cerium sulphate appear. Filter out the crystals. Wash them, while they are still on the filter paper, with about five cubic centimeters of hot water. This will remove

any traces of iron sulphate. Let the wet filter paper drain, and then redissolve the crystals in a small amount of cold water. You will now have a purified solution of cerium sulphate.

Place about an inch of your solution in a test tube, and warm the tube. If the solution does not contain too much water, the glistening needlelike crystals of cerium sulphate will separate out again. Continued gentle heating will evaporate the excess water, as in the first separation, in case the crystals fail to appear at once. Stop heating the tube as soon as they are formed. As the liquid cools, the crystals pass back into solution. Add a drop or two of water, if required, to make them redissolve completely. This yields a cerium sulphate solution that is saturated at room temperature.

Seal the tube hermetically, to prevent any further change in the strength of the solution by evaporation, and it will make an interesting addition to your "chemical museum" of laboratory curiosities. At any future date you can plunge the tube in hot water, and crystals of cerium sulphate will form; when you let the tube cool, they will redissolve. For this purpose the tube may simply be tightly corked, or you can heat its end in a Bunsen flame and draw out the softened glass with forceps to make a perfectly air-tight seal.

You can perform a simple test for the presence of cerium in cigarette-lighter flints and other materials. Dissolve a flint (*Continued on page 124*)

PRECIOUS METALS EXTRACTED FROM COMMON PRODUCTS OR FROM INEXPENSIVE CHEMICALS PROVIDE MANY NEW AND FASCINATING TESTS

By
Raymond
B.
Wailes



The test for cerium in a cigarette-lighter flint. If the metal is present, a brown precipitate appears when the proper reagents are added

To see the tiny particles of gold in a colloidal solution, arrange a lamp so that it will shine into the liquid through a small hole in a piece of cardboard, as illustrated at the right. The path of the light beam is made visible by the suspended particles



Cerium sulphate has the strange property of dissolving more readily in cold than in warm water. In this experiment, a solution precipitates crystals when it is warmed, and redissolves them again as it cools, thus reversing the usual process

ANYONE CAN
BUILD THIS

World's Smallest

SMALL enough to be carried in your coat pocket and weighing less than ten ounces, the ingenious transceiver illustrated hits a new high in compactness. Operating on a wave length of three quarters of a meter, it serves as both transmitter and receiver to allow you to carry on regular two-way, telephonic conversations for distances up to one half a mile.

The midget circuit is the result of more than two years of experimenting. Built around a 955 acorn-type tube, the hook-up has been reduced to the barest essentials. Four small batteries make up its power supply, while its antenna consists simply of two short lengths of wire mounted on top of the cabinet.

As shown in the diagram, the circuit is a simple dual hook-up operated by a double-pole, double-throw switch. With the switch in one position, the parts are

arranged as an efficient high-frequency oscillator capable of generating frequencies between 250 to 400 megacycles a second. With the switch in the receiving position, a grid leak and condenser are placed in the circuit to make it a sensitive, well-balanced receiver.

As in all ultra-high frequency units, the outfit must be constructed carefully if the best results are to be obtained. The specifications for the parts and the placing of the units must be followed closely. This is particularly true of the coils (L_1 and L_2) and chokes (Ch_1 and Ch_2).

The two inductance coils consist of No. 16 enamel copper wire wound on temporary one-quarter-inch forms. These can be short lengths of drill rod or dowel. When removed from the forms, the windings should be carefully spread out to allow a one-sixteenth-inch space between turns. Each coil should consist of approximately one turn to cover the three-quarter-meter band. For the one and one-half-meter band, they should consist of two turns. How the coils are mounted by soldering the leads to the grid and plate terminals of the tube socket is clearly shown in the photographs.

In winding the two choke coils, use No. 30 enamel or cotton-covered copper wire and mount them on the fixed condenser C_1 , as shown in the sketch. Short lengths of dowel rod will serve as the one-quarter-inch forms.

The side view below shows the hook-up fitted into its pocket-size aluminum cabinet

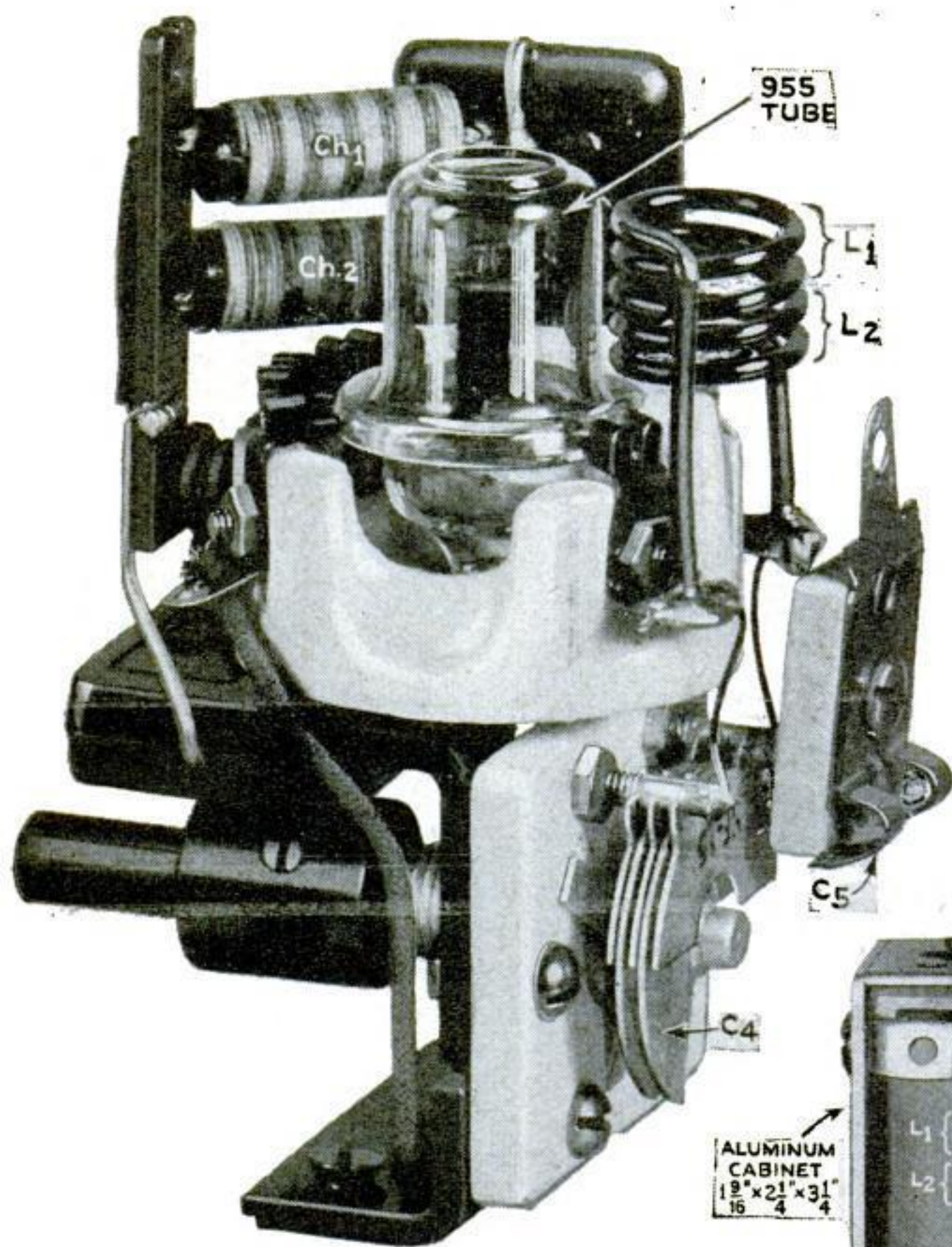
The main tuning condenser, of the midget variety, should have a maximum capacity of 10 mmf. If a suitable unit, is not readily available, the capacity of a 15 mmf. condenser can be easily reduced to approximately the required value by removing one or more of the movable plates.

When assembling the various parts, make all connecting leads as short as possible and take particular pains to make good soldered joints. Any additional resistance, due to long leads or poor connections, may upset the balance of the circuit and prevent it from operating effectively. Follow the large photograph of the unmounted assembly when placing the parts.

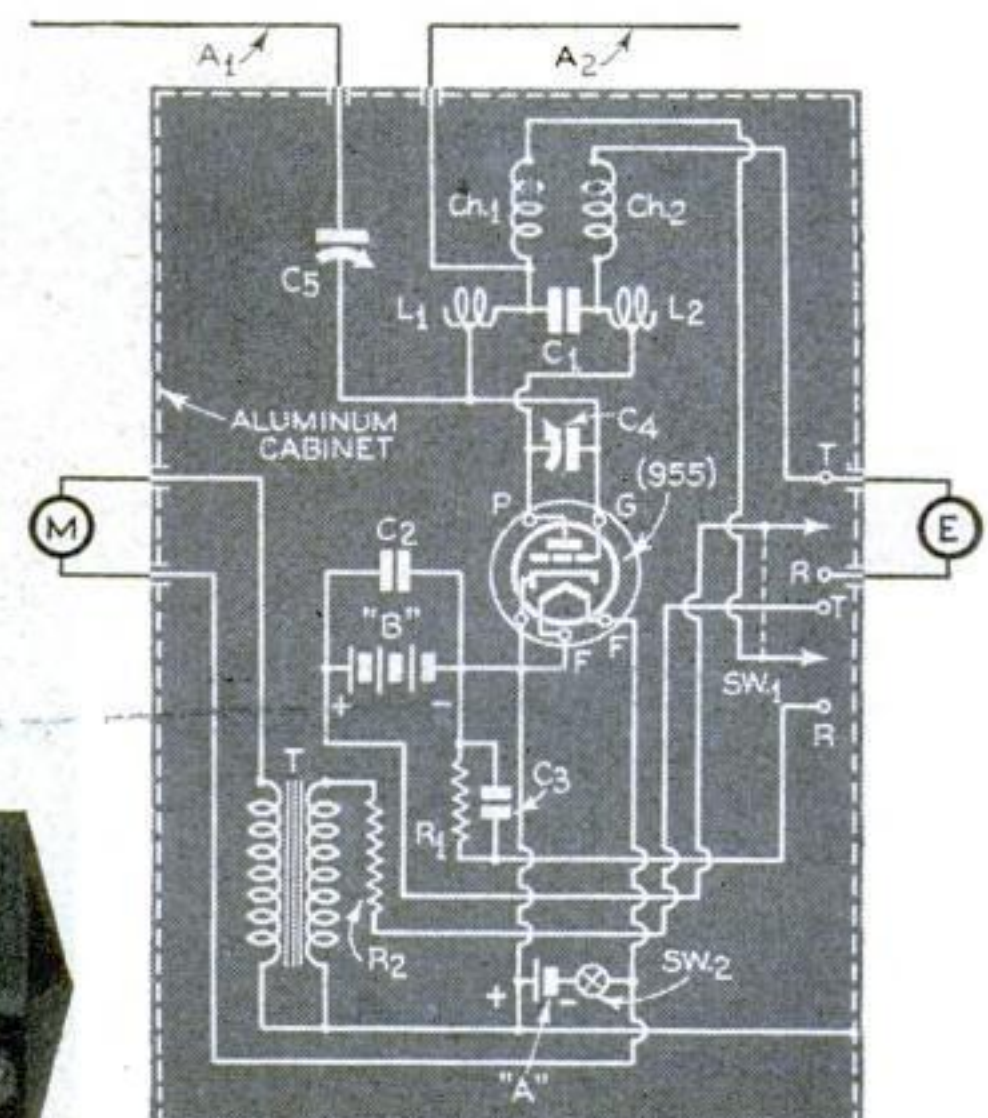
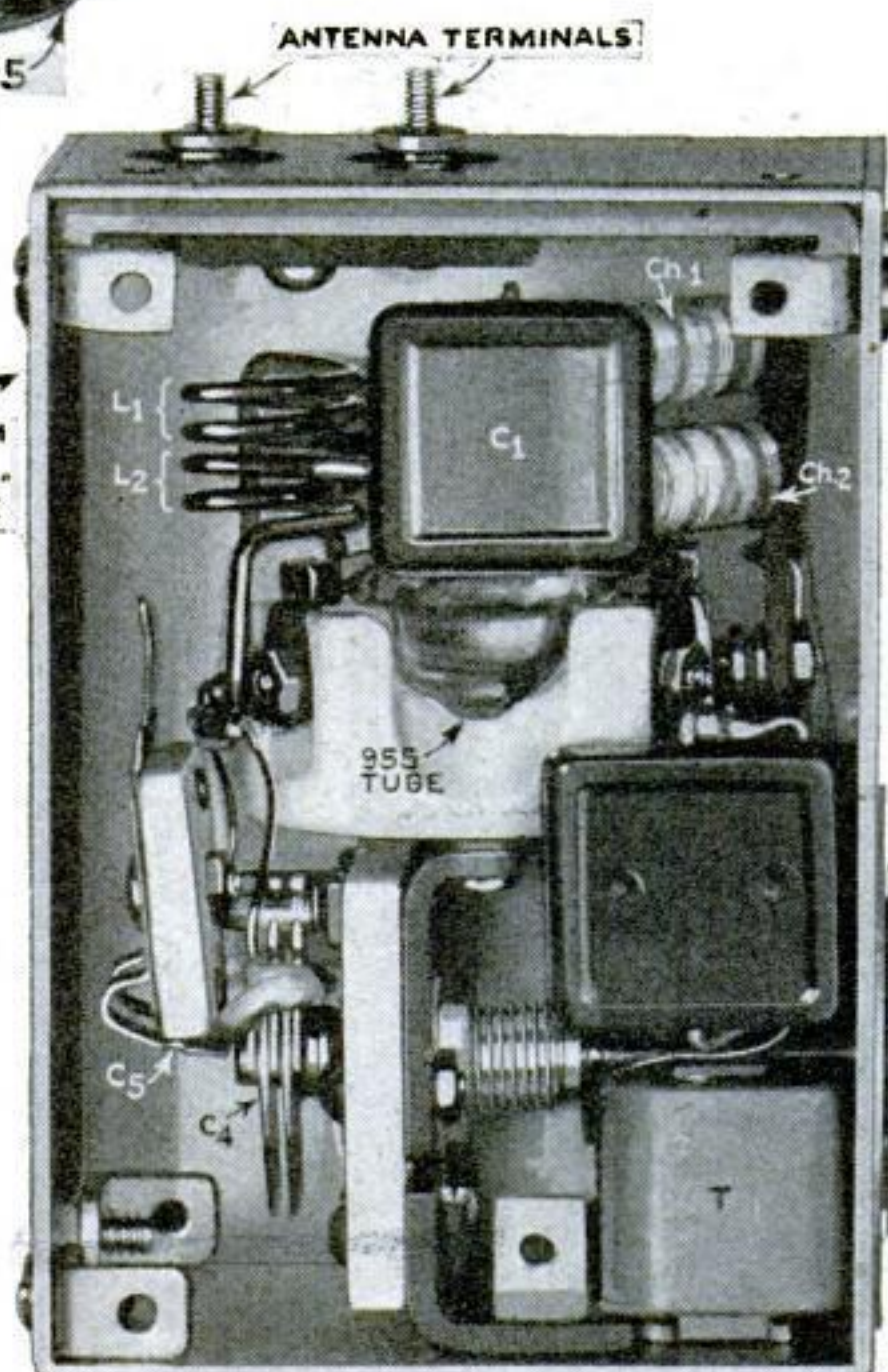
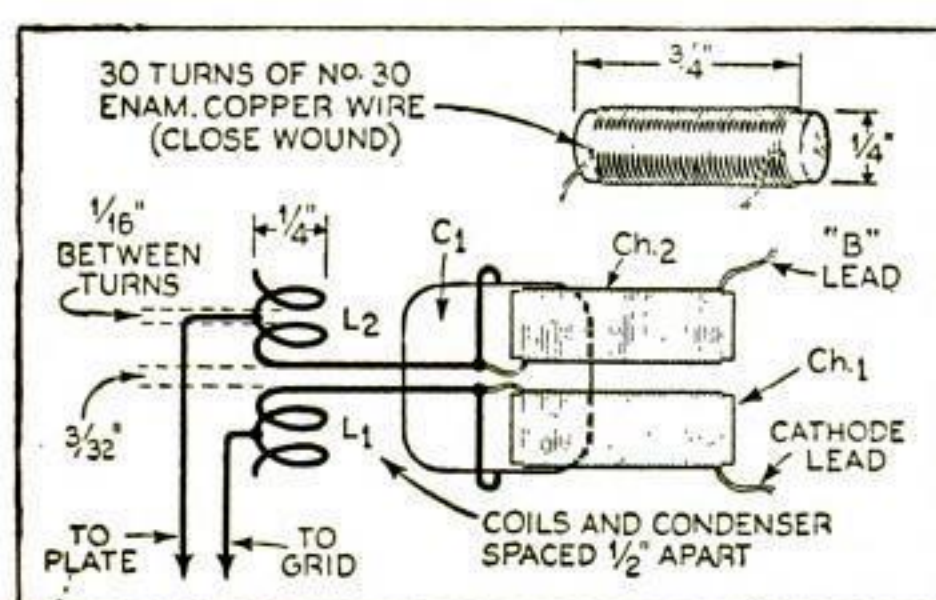
Two small U-shaped brackets formed from composition insulating material provide the main supports for the tube socket and the tuning condenser. Another composition bracket supports the free ends of the two choke coils. Because the regular shaft on the tuning condenser is short, a composition extension shaft must be supplied for it.

WHEN making the compact aluminum cabinet, check the dimensions of your completed assembly. In wiring the parts, you may have made the circuit slightly larger than the original shown, in which case the dimensions of the cabinet may have to be altered to suit. The actual construction of the cabinet, however, should cause little difficulty. The one-sixteenth-inch-thick sheet aluminum used can be easily bent to shape in a bench vise. The various brackets and angles can be cut from three-thirty-seconds-inch brass.

The microphone, a midget 200-ohm unit, is mounted directly on the front face of the cabinet. It is wired into the circuit through a microphone input



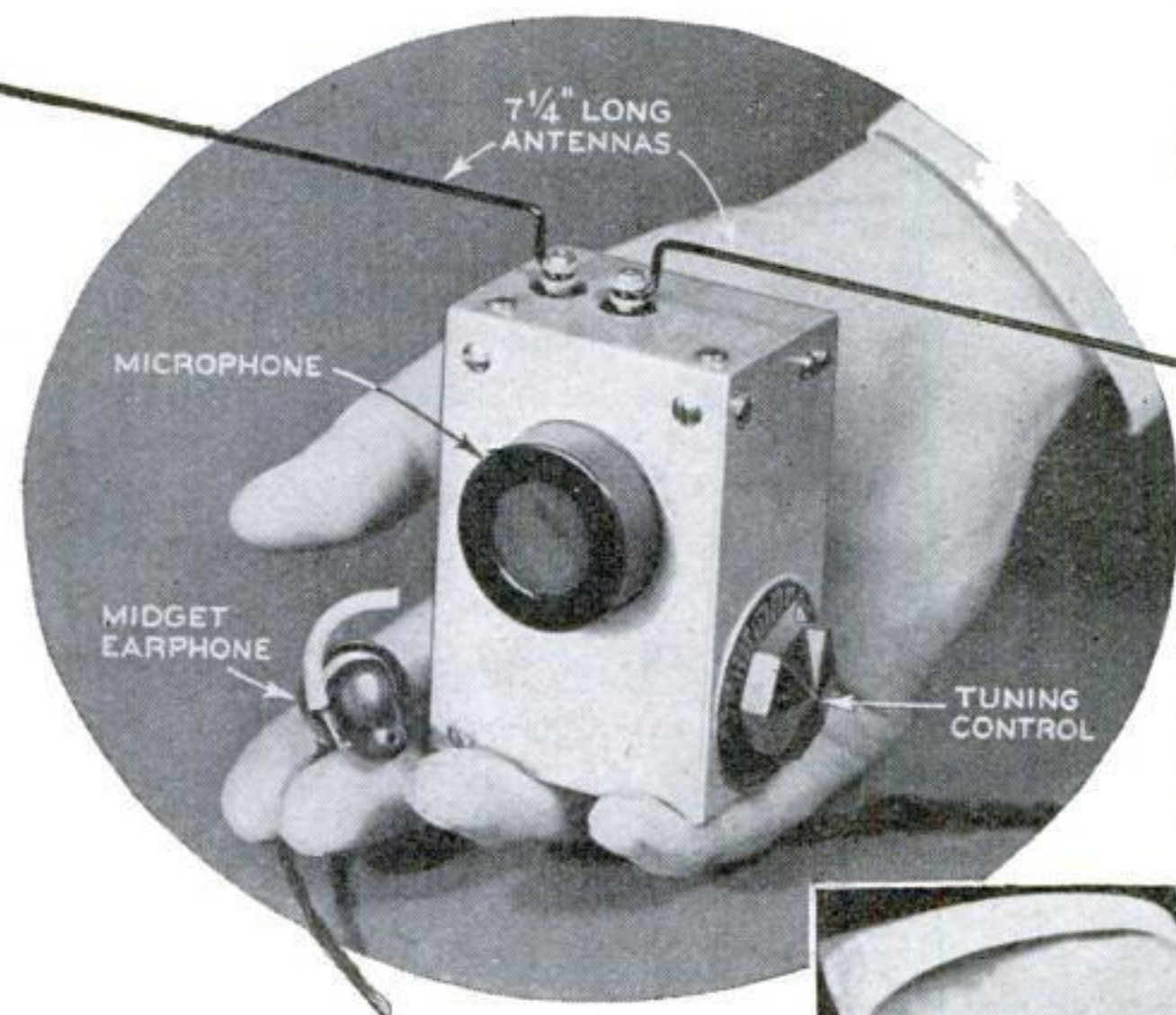
The completely wired circuit, showing how the coils and chokes, wound as below, are mounted



When wiring the midget transceiver, follow this diagram closely. If good results are to be obtained, use care on all connections

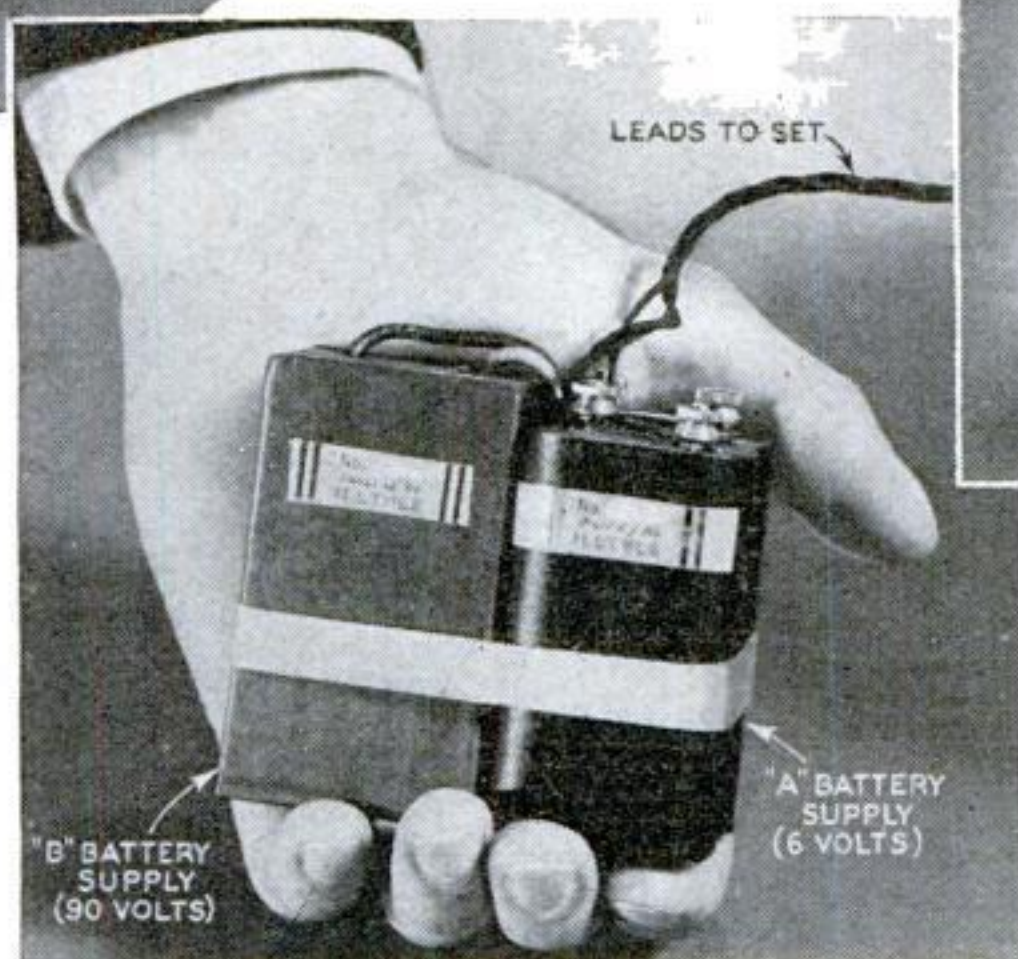
Two-Way Radio

By CHARLES ALEXTUINAS



The designer and his compact transceiver. Two short wires act as a di-pole antenna

Complete with batteries, the small outfit can be held in two hands, as at left and below



transformer made from a 1,000-ohm earphone coil by winding 200 turns of No. 36 enamel copper wire over the original winding. The new winding serves as the primary, the old as the secondary.

Although any midget earphone having a resistance of more than 2,000 ohms will serve with the unit, a receiver of the hearing-aid type is both sensitive and compact. It can be connected to the circuit with flexible leads as shown in the photographs.

Several methods can be used in installing the double-pole, double-throw, change-over switch. It can be mounted in the cabinet, as indicated in the diagram, or wired into the power leads

directly under the cabinet. The second method will cause the least amount of difficulty, but will increase the overall dimensions of the complete unit. If mounted inside the cabinet, a push-button type switch should be used. If installed outside of the cabinet, a regulation toggle unit will serve.

Microphone and filament current is supplied by two flat flash-light cells wired in series to give a total voltage of approximately six volts. For the plate circuit, two midget forty-five-volt "B" batteries are used. The batteries can be arranged in a compact bundle that will fit easily into your hip pocket. The power leads from the batteries to the circuit should be flexible and well insulated.

Before operating the transceiver, check the wave length to make sure that you are operating within the amateur wave band. This can be done by constructing a simple wave meter consisting of a flat U-shaped loop of wire (five feet of No. 12, bare) and a 115-ma. galvanometer. The loop, bent so that the two legs are parallel and spaced approximately three inches apart, should be mounted on small insulators fastened to a wood baseboard.

With the transmitter in operation, bring the antenna close to the U-shaped wire and slide the terminals of the meter slowly up along the loop until a

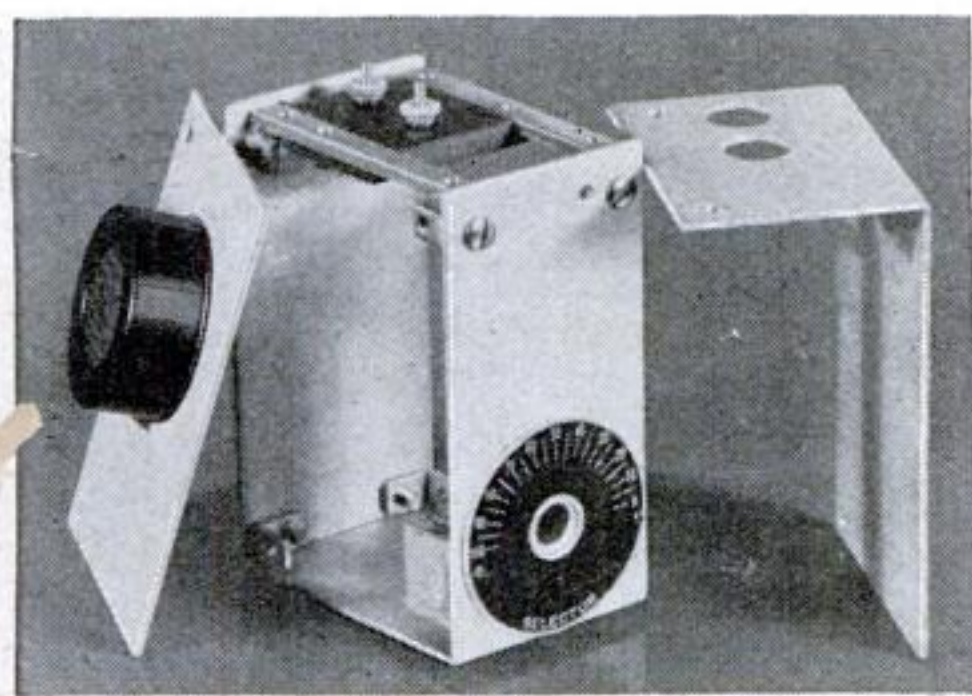
maximum current reading is indicated. The wave length of the circuit then can be found by measuring the length of wire from one of the meter terminals around the loop to the other terminal. Once tuned, the condenser stays the same for both transmitting and receiving.

Like all transmitting units, the midget transceiver should not be operated unless you are a licensed amateur. However, if you are considering trying for your license in the near future, the construction of the circuit will teach you many of the radio fundamentals that form the basis of the examination.

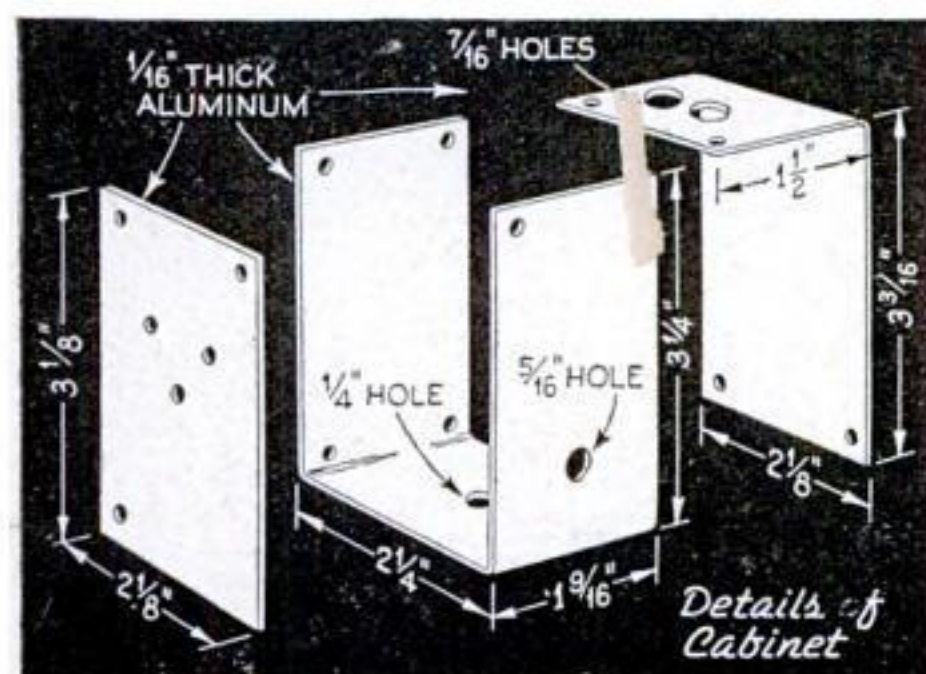
LIST OF PARTS

- C₁.—By-pass condenser, .0003 mfd.
- C₂.—By-pass condenser, .006 mfd.
- C₃.—Condenser, grid-leak, .004 mfd.
- C₄.—Tuning condenser, 10 mmf. (see text).
- C₅.—Trimmer condenser, 3 to 30 mmf.
- R₁.—Fixed resistance, grid-leak, 20,000 ohms.
- R₂.—Fixed resistance, 10,000 ohms, 1/2 watt.
- L₁.—Inductance coil (see text).
- L₂.—Inductance coil (see text).
- Ch₁.—Radio-frequency choke (see text).
- Ch₂.—Radio-frequency choke (see text).
- M.—Midget microphone, 200 ohms.
- E.—Midget earphone, 2,000 ohms.
- T.—Microphone transformer (see text).
- Sw₁.—Single-pole switch.
- Sw₂.—Double-pole, double-throw switch.
- A₁ and A₂.—Antenna wires, No. 16 enam. copper wire, 7 1/4 in. long.

Miscellaneous.—One 955 acorn-type tube, aluminum, brass, composition sheet insulation, batteries, socket, knob, dial, solder, wire, etc.



Made from thin sheet aluminum, the cabinet can be easily bent to shape in a vise



New Ideas for Radio Fans



How parts are arranged in the radio turntable, shown in use in the photograph at the right



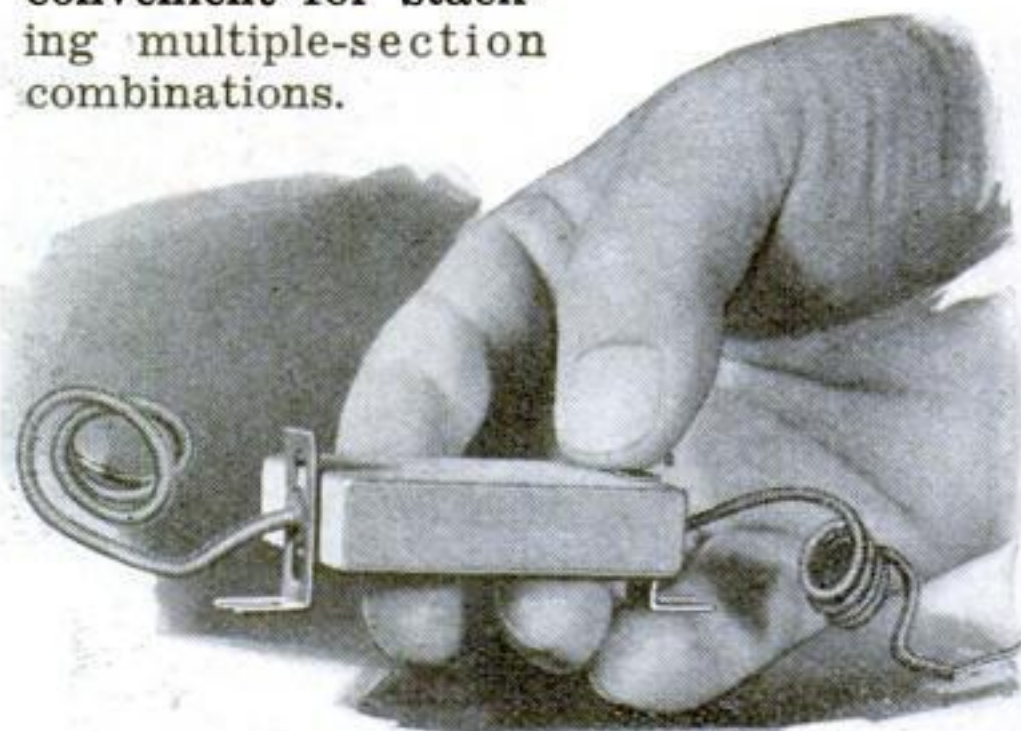
Turntable for Bedside Radio Aids Tuning

INCREASING the handiness of a small radio, a swivel-base mounting is particularly useful for receivers placed between twin beds. The occupant of either bed, by simply reaching out his hand, can turn the entire set to face him, and adjust the dials with little effort. The mounting can be easily constructed

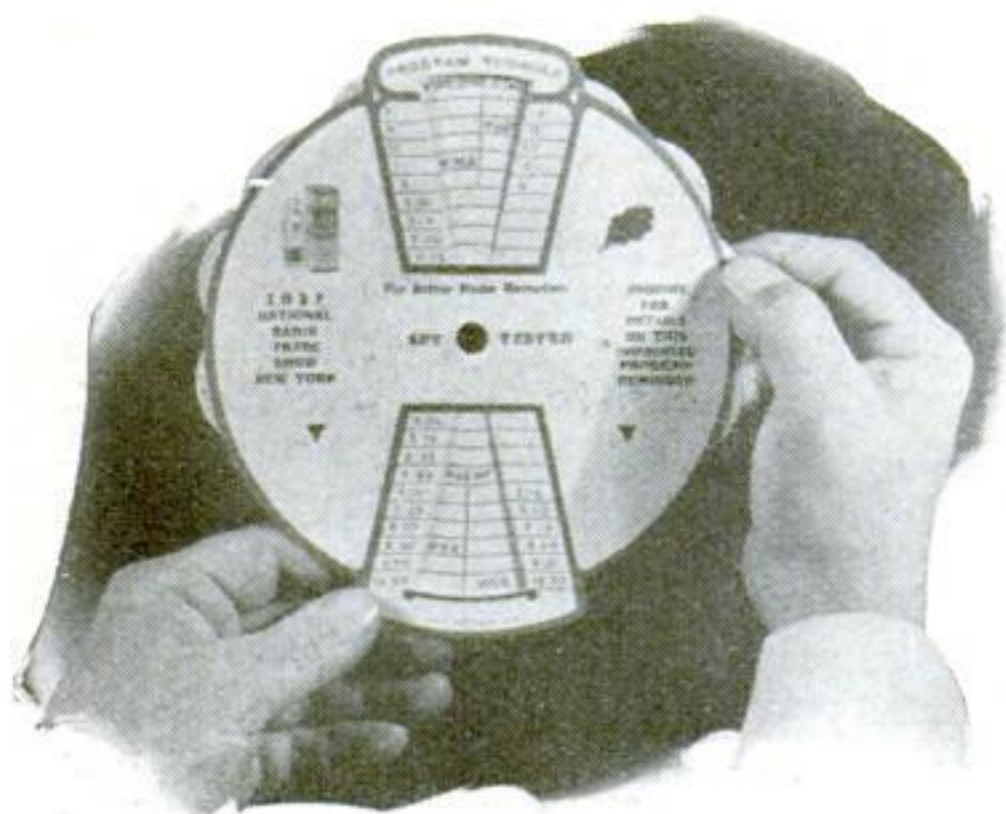
from two die-cast white-metal pulleys about four inches in diameter, one being fastened to the bottom of the radio, the other to a wooden base, and both mounted on a short section of metal shaft. The mounting may be finished to match the cabinet with which it is to be used.—R.A.C.

New Condenser Has Adjustable Mount

MOUNTING lugs attached to the ends of the electrolytic, high-capacity condenser shown below can be lengthened, turned, or bent to any desired angle, permitting the radio builder to fasten them easily to the chassis. They also are convenient for stacking multiple-section combinations.



Easily adjusted, the lugs on this condenser can be turned or bent to fit any mounting

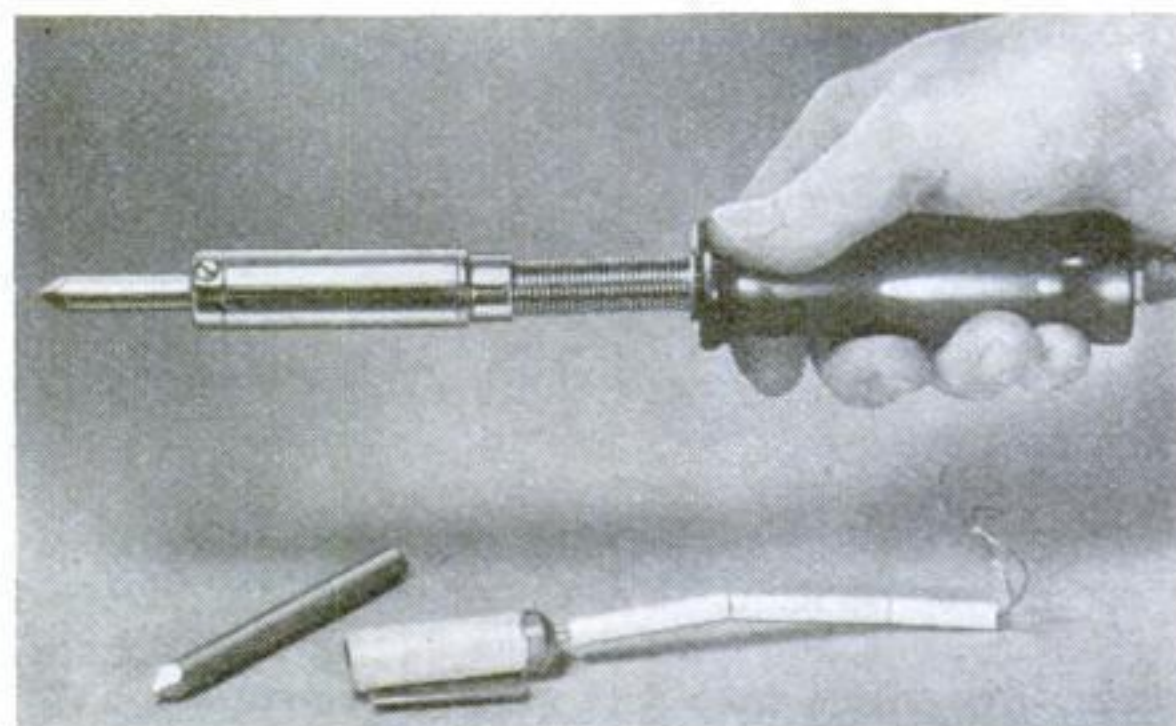


Program Reminder Tells What Stations To Dial

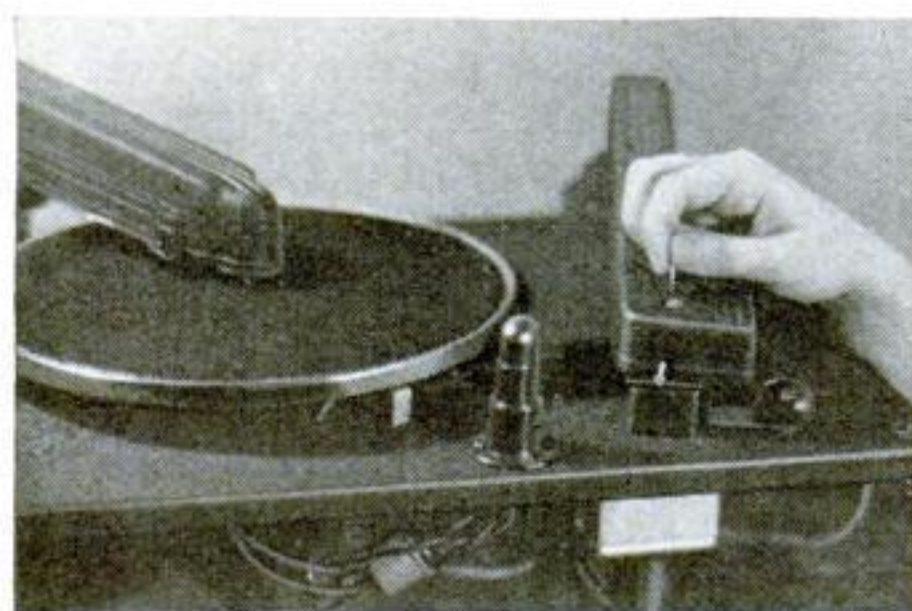
TO REMIND the radio listener when his favorite programs are on the air, the adjustable cardboard dial shown above was devised. Days of the week are printed near the rim of a rear disk. Below them blank spaces appear through openings in the front disk. Bordering the openings are the hours of the day. Station call letters written in the spaces appear opposite the proper time of day.

Soldering Iron Has Flexible Spring Handle

HAVING a spiral steel-spring shank, a unique electric soldering iron reduces muscular fatigue in the hands and wrists during constant use, and insures uniform pressure on the joint being soldered. In addition, the spring acts as a heat dissipator to keep the handle cool. The plunger-type tip, extending through the entire length of the heating element, is replaceable, and flexible insulation protects the connecting wires that pass through the spring.



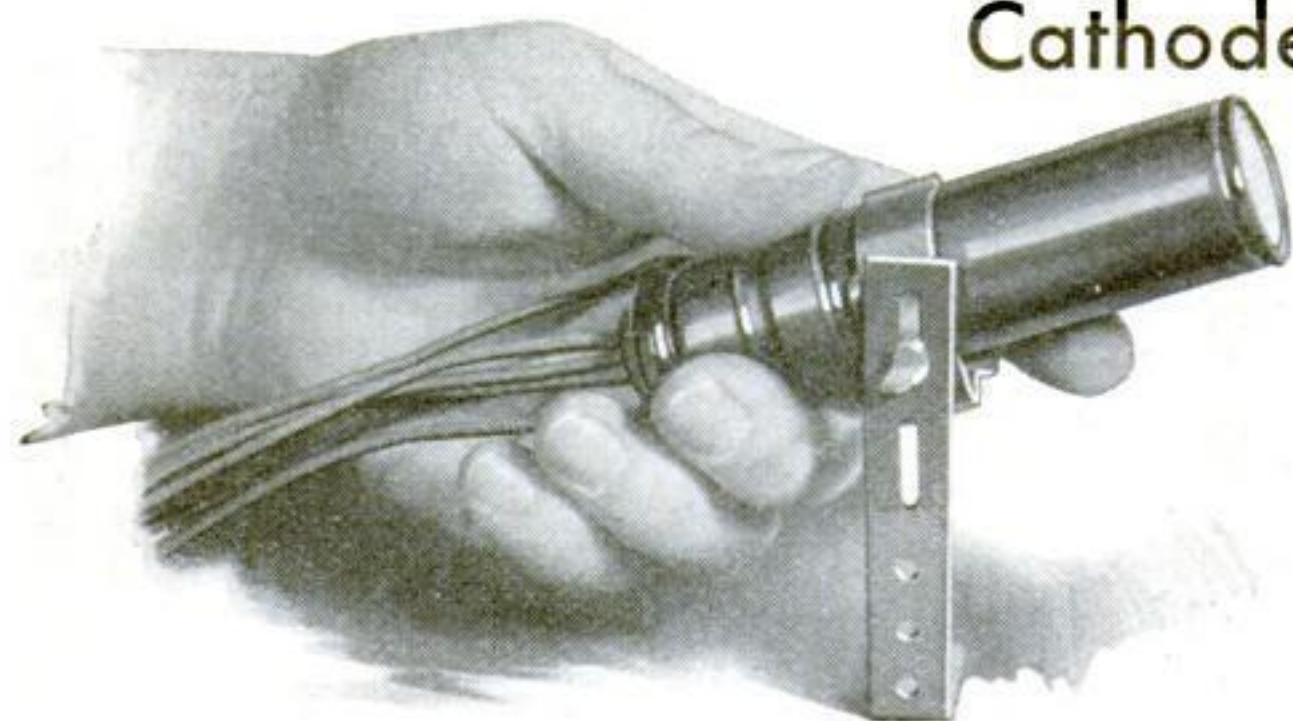
The coil-spring shank of the soldering iron gives an even pressure against a joint, and keeps the iron's handle cool



Needles Fed from Top in New Pick-Up Arm

DOING away with the awkward method of inserting phonograph needles at the bottom of the tone arm, a new pick-up arm receives the needles from above. The new needle passes through a channel provided for the purpose, and locks into the conventional position.

Cathode-Ray Tube Holder Is Easily Adjusted

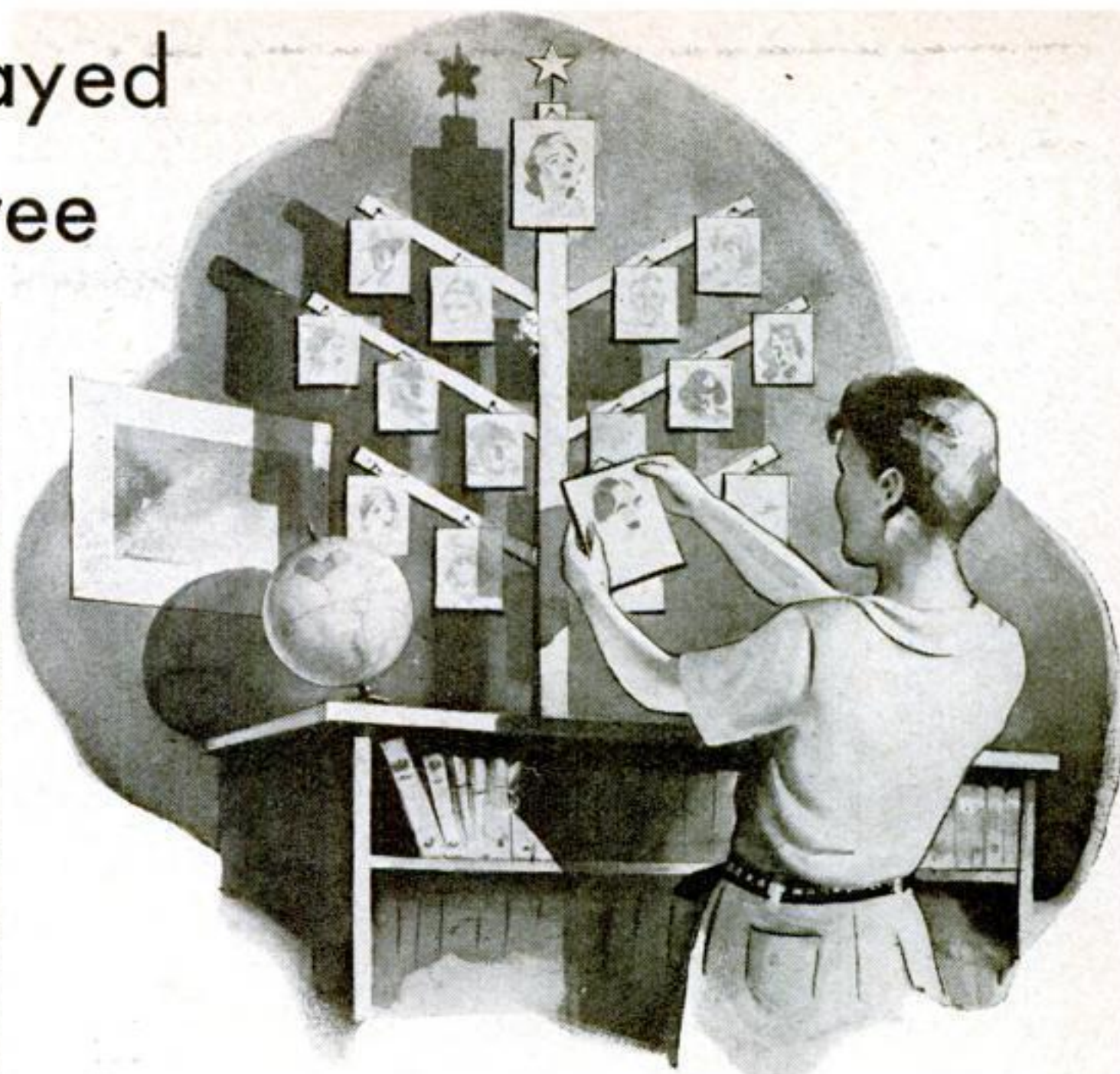
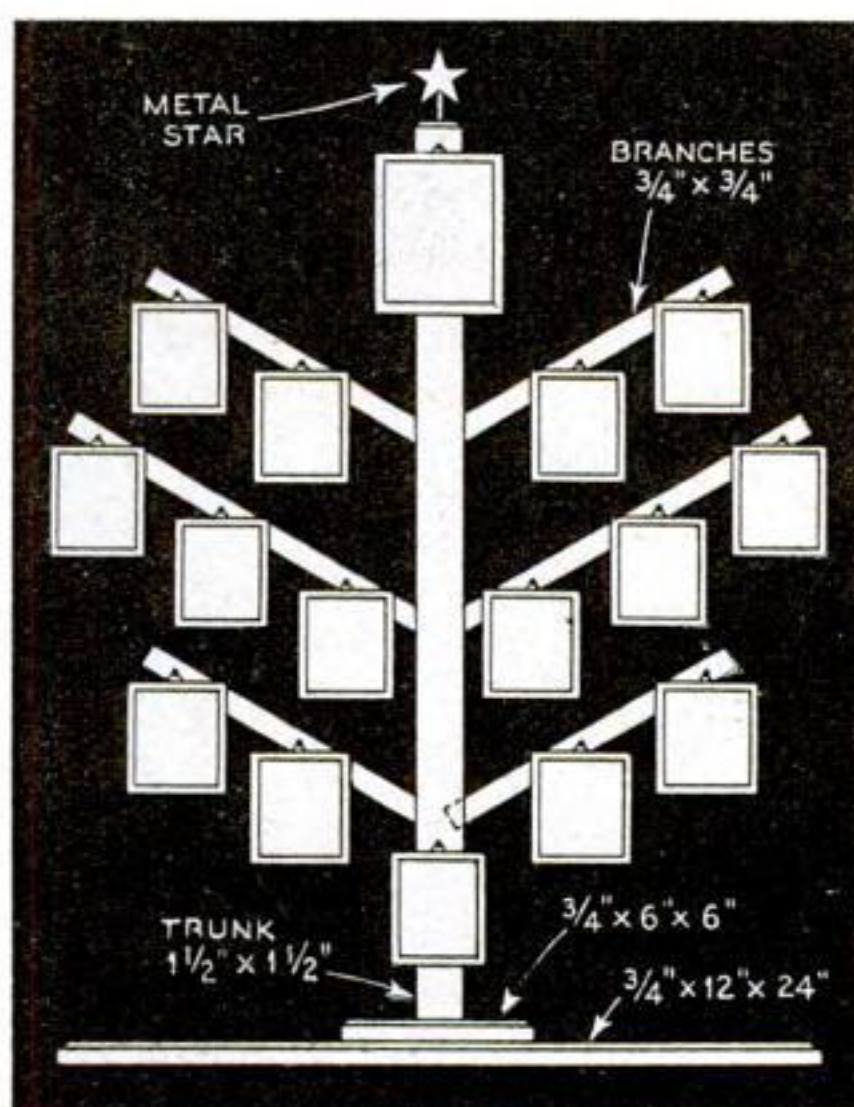


DESIGNED for use in small oscilloscopes and similar equipment used in testing receivers and public-address amplifiers (P.S.M., May '37, p. 72), the combination socket and bracket shown provides a convenient mounting for the small cathode-ray tubes now available at low cost to amateur experimenters. The well-insulated socket, which is completely wired

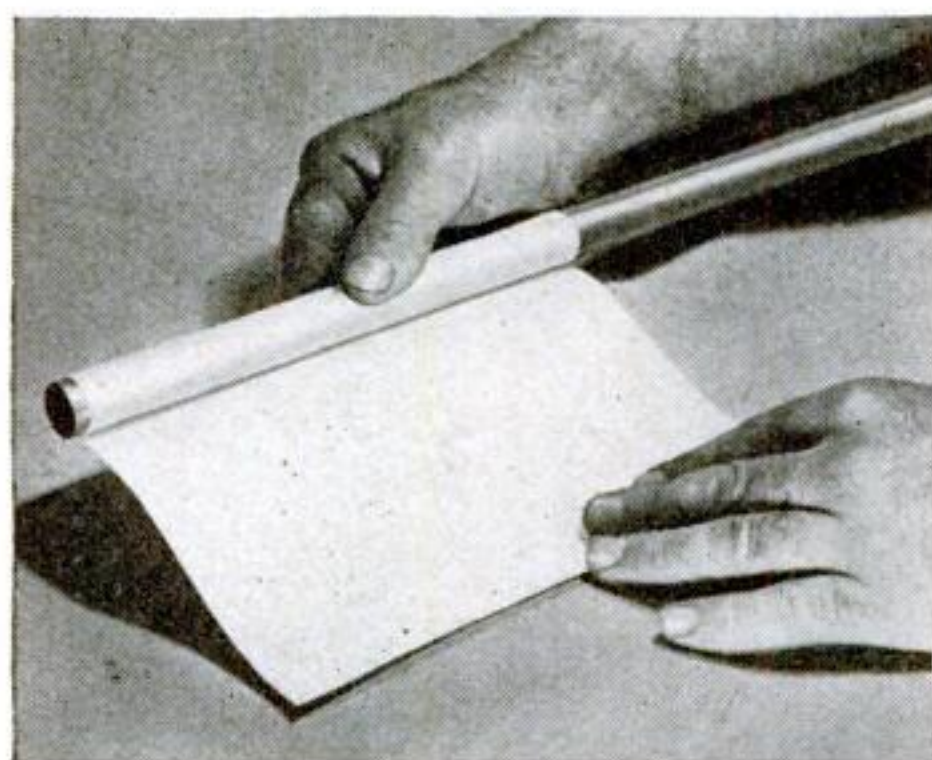
and ready to receive the tube, needs only be connected into the circuit, while the metal holding bracket grips the sides of the tube firmly and allows it to be clamped in any desired position and at any height simply by adjusting a conveniently located thumbscrew. The assembly can be mounted on a chassis or in a cabinet with two bolts or screws.

Photos of Movie Stars Displayed on Modernistic Wooden Tree

COUNTLESS thousands of miniature photos of movie stars are sold, already framed, in ten-cent stores and elsewhere. Those who like to collect such pictures and wish to display their collections in a novel way may do so by making a modernistic "tree." The base is of two pieces of wood, the top one $\frac{3}{4}$ by 6 by 6 in., and the bottom one $\frac{3}{4}$ by 8 by 12 in., or 12 by 24 in., as preferred. Cut the trunk from $1\frac{1}{2}$ -in. square stock. The branches are $\frac{3}{4}$ -in. square pieces set into the trunk with glue, as shown. A metal star is mounted on top of the tree.—D. C.



An arresting way to mount a collection of miniature pictures



End of Rod Cut Square by Using Paper Guide

IT IS often necessary to cut or finish the end of a round rod or piece of tubing so that it is square across. This can be done quickly and easily by using a sheet of paper with one perfectly straight edge. The sheet is wrapped tightly around the cylinder with this edge close to the end that is to be squared off, and this gives a true line all around. The same method may be used for marking a round cardboard box, tin can, or any similar object that has to be cut off on a straight line.—M. T.

Improvised Wooden Tongs Fish Objects up Through Grating

SMALL objects accidentally dropped through gratings may be retrieved by use of two thin pieces of box board, a small block, and a strong rubber band. Place the slats together, wrap the rubber band around them, and insert the block as shown. The device may then be used like a pair of tongs. If made on a small enough scale, the tongs will serve for picking up tiny machine screws.—FLOYD MCCrackEN.



The tongs as assembled for retrieving a watch

Removing the Stickiness from Friction Tape

TALCUM powder rubbed into electrician's tape will remove its stickiness permanently. This is sometimes desirable when a splice has been made in a wire that is frequently handled, or when a metal lamp socket or some other accessory has been wrapped with friction tape as a protection or binding. It is equally useful when the tape is used for reënforcing a split handle and similar purposes.—FRED MIELKE, JR.



Suction Cup Cleans Grinding Wheels

ALTHOUGH they are often neglected, grinding wheels are very much like cutting tools in that they must be in good condition to give maximum efficiency. Best results cannot be expected from them unless they are cleaned thoroughly at intervals and at least after every dressing or truing operation. Cleaning with a wire brush in a gasoline bath helps, but to remove the grease and dirt from the deeper recesses of the coarser wheels, an ordinary suction cup is much more effective.

Place the wheel in a shallow pan and cover it completely with kerosene or gasoline after stopping the mandrel hole

with a tight-fitting cork or a wooden plug. Apply the suction cup to the surface for a minute or so. This violently agitates the liquid, even drawing some of it clear through the wheel if of coarse texture. A surprising amount of grit and sludge will be removed. Drain and rinse the tray when the liquid becomes very dirty and repeat the operation.



Model Drawings Prepared with Aid of Camera

IN MAKING scale models of machines, bridges, and buildings, the model maker often finds that the available assembly and detail drawings are drawn to different scales. Considerable time can be saved if, instead of making a model drawing to scale, the various parts are all reduced photographically to the true scale of the model. This may be easily done by the photostat process, or more economically with your own camera. In this case, copy the drawing to the largest size the negative will take and then enlarge to the required size.—A. W. E.



Below, an experimental set-up to determine the distance from lens to negative and paper



This enlarger is easier to use than an ordinary contact printing frame. It requires no focusing

ANYONE CAN ASSEMBLE THIS

Fixed-Focus Enlarger

FOR MINIATURE FILMS

PERHAPS the greatest disadvantage of the 35-millimeter and the half vest-pocket size miniature camera, in the eyes of the average amateur, is the diminutive size of the contact prints. If made directly from the film, the prints are too small to put in an album, to show one's friends, or even to determine suitability for enlargement, yet the enlargement of all pictures to a size of 5 by 7 in. or greater is far too costly and time consuming.

A logical solution is to make small enlargements, say $2\frac{1}{4}$ by $3\frac{1}{4}$ or $3\frac{1}{4}$ by $4\frac{1}{4}$ in., from each negative, instead of contact prints. Pictures of this size are inexpensive, convenient to handle, and yet big enough to appreciate.

Although small enlargements may be made with any enlarger, the time required to insert the negative, focus, and adjust the small paper on a big easel seems discouraging. By building a special fixed-focus enlarger, such as the one to be described, all adjustments are eliminated, and the usually fussy job of making small enlargements becomes simpler and more rapid than contact printing.

The present enlarger was designed for 35-mm. film, a lens of 2-in. focal length, and an enlarged print of $2\frac{1}{4}$ by $3\frac{1}{4}$ in., but it may be easily adapted for larger or smaller film, a lens of different focal length, or a print of different size. Except for the lens, the whole apparatus may be put together practically without

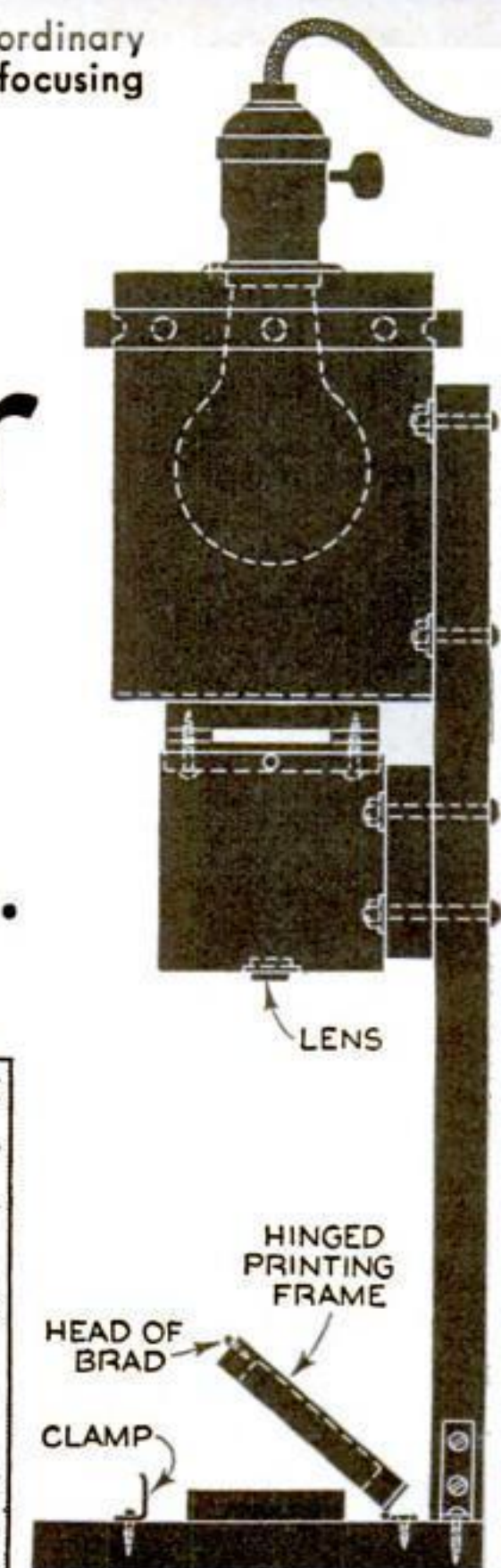
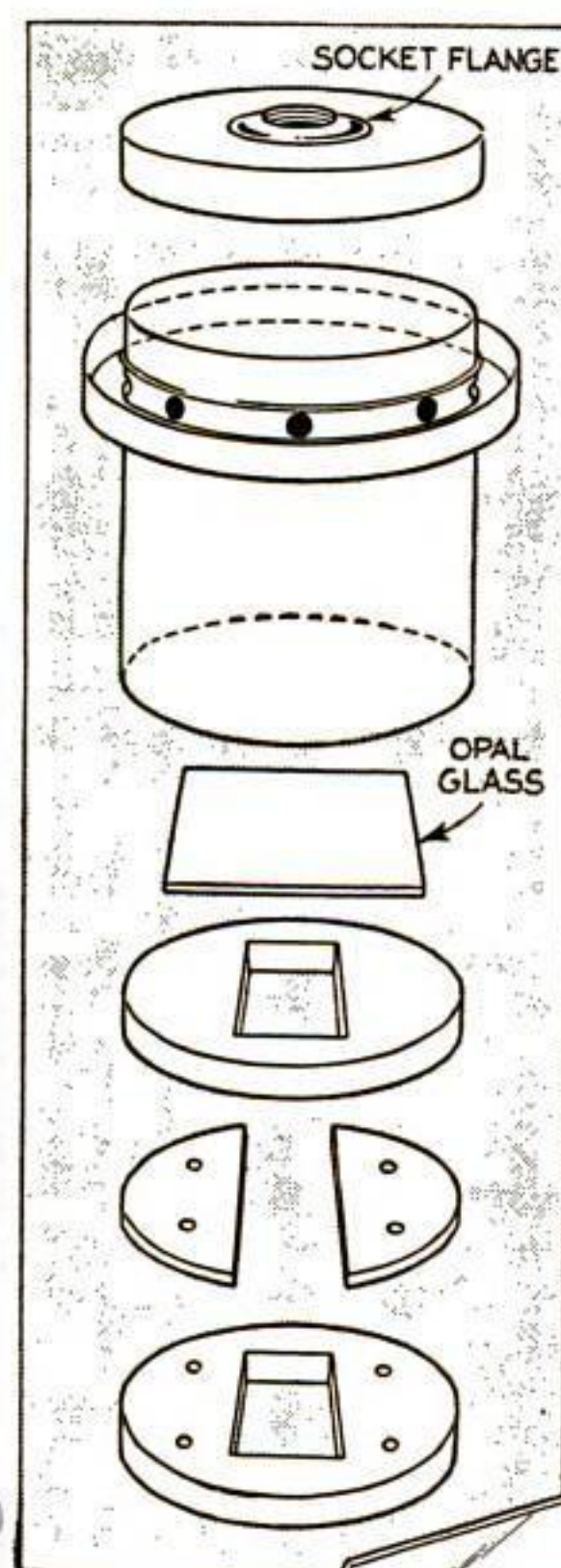
cost from materials generally found about the home. A suitable lens may be obtained from an inexpensive old camera or may be bought, or the lens of your miniature camera may be used, if it is removable.

Extra speed in making prints is attained by using an adapted printing frame for holding and masking the paper, and by using a special negative carrier that enables six different pictures to be printed in succession without having to remove the strip (Continued on page 114)

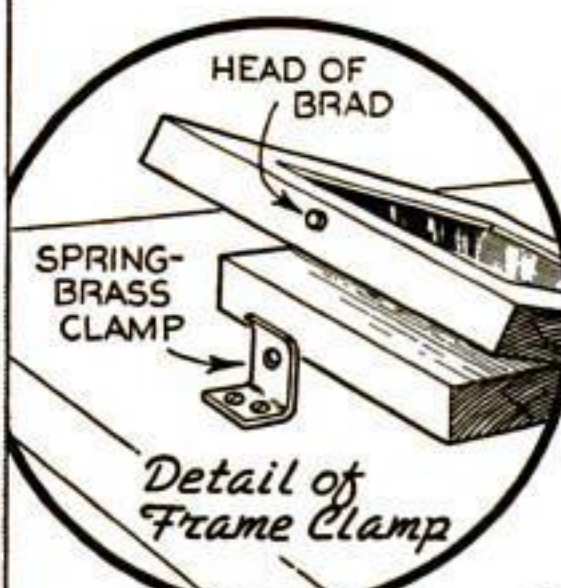


A screw-top coffee can is used for the lamp housing, with a socket flange soldered on. Right, the details

By
Kenneth M.
Swezey



Side view of enlarger, completely assembled



Enjoy new thrills...develop new skill... make **Snapshots at Night**

ALL YOU NEED

1.

Your present camera loaded with Kodak "SS" Film



2.

Two or three
Photoflood lamps
in Kodak
Handy Reflectors



YOU'LL find snapshots at night almost as much fun as taking up photography all over again. Working out interesting picture situations, gauging distances, placing your subjects, arranging lights—you're an artist working with a new medium. Snapshots after dark aren't at all difficult—but they are interestingly different.

Equipment is simple and inexpensive. You don't need a high-priced camera—not any more. Any camera that can be loaded with Kodak "SS" Film will do the trick—even the simplest Brownie.

With "SS" Film, you use two or three of the new No. 2 Mazda Photoflood lamps, which last for hours, and inexpensive Kodak Handy Reflectors. If your particular camera is equipped with an $f.6.3$ or faster lens, then the No. 1 Photoflood lamps are quite powerful enough.



FREE BOOKLET . . . Suggests a variety of picture opportunities . . . shows you how to arrange your lights . . . how to place your subject . . . tells you everything you need to know about two ways to make night pictures—*snapshots* with Photoflood lamps, *fast exposures* with Photoflash lamps. (You can use Photoflash lamps, each good for one picture, if your particular camera can be set for "time.") The directions are simple and easy to understand. Be sure to get a free copy at your dealer's today . . . Eastman Kodak Company, Rochester, N. Y.



Members of the Massachusetts Model Railroad Society study a new layout for their track system. This active club maintains its own clubroom and library in Boston

Homeworkshop Guild Model Makers

EXPAND THEIR ACTIVITIES

LOCOMOTIVE models are roaring along new track systems, tiny airplanes are soaring to new records, and replicas of famous ships are being erected in miniature shipyards as model makers belonging to the National Homeworkshop Guild push forward with enlarged activities.

The Massachusetts Model Railroad Society, Inc., which has its own clubroom in *Boston, Mass.*, recently increased the track layout of the "Massachusetts Bay Lines." Carpenters constructed new benches, and the tracklaying crew followed close behind, as shown in the photograph above. The officers are Lester D. Friend, president; George Waitt, vice president; Wilfred L. Hurley, secretary; Ralph Barrows, treasurer.

Up in *Ottawa, Canada*, the Society of Model Engineers has joined forces with the Gas Model Aircraft Club, although the two clubs will maintain their own identities. A. E. French, who is president of the S.M.E., was elected to the board of the airplane club as secretary-treasurer.

The Homcraft and Modelmakers Guild of *Richmond, Va.*, sponsored its annual exhibit at the Y.M.C.A. recently and was host to thirteen members of the Capital Homcraft Club of *Washington, D.C.*, on the night the winners were selected. T. W. Stone's equatorial telescope

mounting was voted the most outstanding piece of work. Others who won awards follow: Gordon Hammond, for a Hepplewhite chair; R. H. Athearn, leather pocketbook and turned wooden tray; W. T. Brennen, wrought-iron floor lamp; L. H. Perrot, *Sea Witch* ship model and model of covered wagon with oxen; H. D. Mollart, miniature tilt-top table; Dr. M. Grove-Hagan, carved plaques; Tuck Fuqua, working model of tugboat.

Programs of wide variety have been enjoyed by the Tri-State Homeworkshop Club, *Sioux City, Iowa*, since its organization last April. These have included a demonstration of gluing by A. C. Whiteman; moving pictures secured through H. A. Morrill; and a discussion of tool sharpening by Charles Dietschey.

Lawrence Schwartz is chairman of a membership drive conducted by the

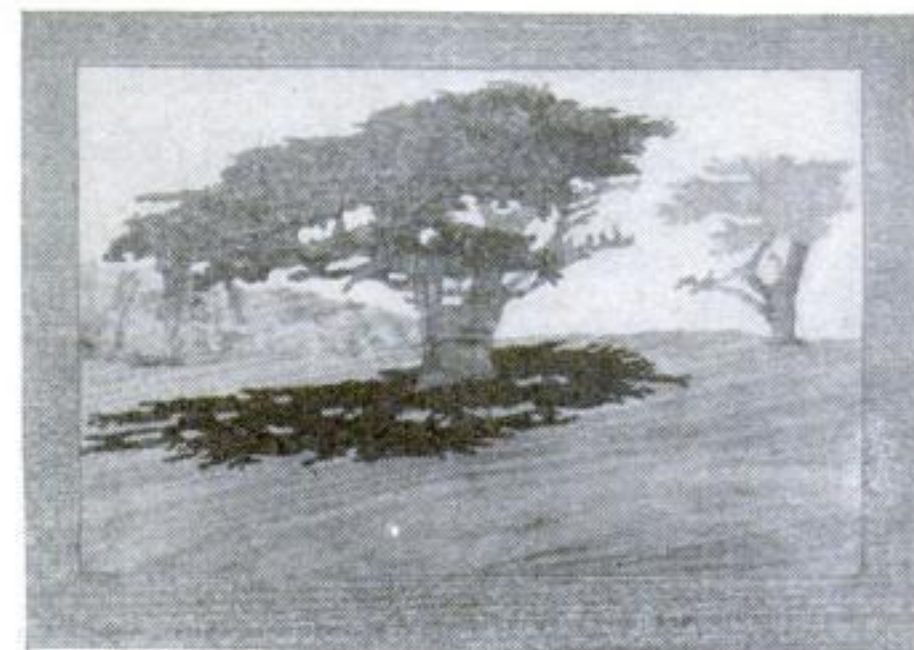


Coulee Dam (Wash.) workshop club in the shop of A. F. Darland

Tinicum Homeworkshop Club, *Lester, Pa.* . . . The *Brunswick (Me.)* Homeworkshop Club repaired toys for the Parent-Teacher Association and the Red Cross . . . Each member of the *Hudson (Mass.)* Craftsman Club is making one useful article to donate to the club, and these will be used as prizes for the best original idea submitted each month . . . As a service to its members, the *Jacksonville (Fla.)* Homeworkshop Club has prepared a mimeographed list of catalogues and pamphlets in its library.

Early California furniture for a six-room house is being constructed by the California Craftsmen's Guild, *Oakland, Calif.* . . . When the *Marion (Ohio)* Homeworkshop Club organized recently, the first meeting was spent in looking through magazines so that each member could select a project on which to begin work at once . . . Members of the *Vicksburg (Miss.)* Homeworkshop Club visited local sawmills and arranged to get seasoned walnut, cherry, gum, and other woods . . . The Sunset Social and Hobby Club, *Brooklyn, N.Y.*, has just completed remodeling its clubroom.

Wood carving by means of sand blasting was demonstrated to the *Denver (Colo.)* Homeworkshop Club recently . . . Officers of the Brookhaven Homeworkshop Club, *Chester, Pa.*, are George Whiteley, Jr., president; Herbert Kimley, vice president; Ethel M. Brown, secretary-treasurer; Louis Whiteley,



Wood-inlay picture made by W. E. Mitchell, of Spokane, Wash. Note shadow of tree

George Whiteley, Sr., and Oscar E. Holmes, Jr., trustees . . . Meetings of the *Oregon (Ill.)* Homeworkshop Club have proved so successful that they are held weekly in the high-school shop under the direction of John H. Carr . . . The Garden State Homeworkshop Club, *Newark, N.J.*, has been constructing a miniature village and a combination desk and bookcase . . . A. W. McIntosh, secretary of the Mazda Homeworkshop Club, *Euclid, Ohio*, demonstrated how to make wood-inlay pictures at a recent meeting. A. A. Armstrong is building door chimes, and L. Zust has completed a utility cabinet . . . The home workshop of a local manual training instructor was visited by the Kerrisdale Homeworkshop Club, *Vancouver, B.C., Canada*. An informal hobby show was held in December . . . An inlaid picture of "The Last Supper," which contains several thousand pieces, was shown to members of the Tri-City Homeworkshop club of *(Continued on page 107)*

Clubs Expand Activities

(Continued from page 106)

LaSalle, Peru, and Oglesby, Ill., by Rufus Charles, who demonstrated how he makes such pictures. W. Menning talked on "Glue Facts" at the home of J. C. Rucinski.

Dr. L. E. Bovik donated a $\frac{1}{4}$ -h.p. motor and a large light to the North Shore Craftsman Club, **Waukegan, Ill.** C. H. Dalton showed how to make attractive things from alabaster and gave the members a generous supply so they could try their hand at it. Old toys were reconditioned for Christmas.

Fred B. Smart discussed filing and setting handsaws, circular saws, and band saws at a meeting of the **Coulee Dam (Wash.) Homeworkshop Club** in the home of A. F. Darland. Mr. Darland exhibited a new heat-treating furnace built from odds and ends (except the element) with which he will make his own tools and machine parts.

Officers of the newly-organized **Lewis-Clark Homeworkshop Club, Lewiston, Idaho**, are W. D. Lundstrum, president; Ira S. Dole, vice president; H. T. Anderson, secretary; Oscar Ranzenbach, treasurer. Recent programs have included a talk on safety devices for the jointer and table saw by E. J. Warner, demonstration of sharpening tools by P. J. Rawson, exhibition of inlay by P. O. Weisgerber, and demonstration of lathe work by August Peterson. Mr. Rawson used two meetings to make an end table with power equipment.

Richard Iverson, secretary of the **Jumbo Homeworkshop Club, Chicago, Ill.**, is making a model of old Fort Dearborn out of match sticks. Nearly all the other members are busy making articles described in issues of **POPULAR SCIENCE MONTHLY**.

Free Bulletin Tells How to Organize a Club

YOUR copy of a three-page bulletin that shows how easy it is to start a home workshop club in your own neighborhood will be sent by the National Homeworkshop Guild upon receipt of a large (legal size), stamped, and self-addressed envelope.

Fellowship with other amateur craftsmen is a valuable aid in your hobby, and it was because of that fact the Guild was organized. Once your club is under way, the Guild will send monthly bulletins and job sheets which contain helpful ideas—all absolutely free.

National Homeworkshop Guild
347 Fourth Avenue, New York

Please send me my copy of the instruction bulletin telling how to start a home workshop club, and inclose an application blank for a free charter. For your use in sending this information I am inclosing a large (legal size), stamped, and self-addressed envelope.

Name.....
Address.....
City.....State.....
(Please print very clearly)

I'M GLAD WE GOT AUNT HATTIE'S LETTER ABOUT COUSIN ED, THIS MORNING

YES, I WOULDN'T WANT TO MISS SEEING HIM IN THE HORSESHOE PITCHING CONTEST

HELLO ROB AND CHUBBINS—I'M SURE GLAD TO SEE YOU, ROB, YOU'RE JUST IN TIME TO GET IN THE CONTEST

NO THANKS, ED, I'LL HAVE MORE FUN WATCHING YOU EXPERTS

A PLAYER PITCHES TWO SHOES IN EACH INNING. IT'S NOT UNUSUAL FOR ALL FOUR SHOES TO BE RINGERS, QUITE A CONTRAST TO OUR GAME, EH CHUBBINS?

HOW LEADING EXPERTS GRIP THE SHOES IN TOURNAMENT PITCHING

LOOK, CHUBBINS, ED GOT TWO MORE RINGERS. THAT MAKES A TIE. NOW, LET'S SEE WHO BREAKS IT

THEY'RE MEASURING THAT LAST PITCH. IT'S CLOSE—YES—ED WINS BY A FRACTION OF AN INCH!

CONGRATULATIONS, ED, THAT'S A MIGHTY FINE PRIZE YOU WON

IT'S THE FIRST PRIZE I'VE GOTTEN SINCE I WON THIS PIPE BACK HOME, REMEMBER ROB?

INDEED I DO, AND I RECALL HOW HAPPY YOU LOOKED WHEN YOU FIRST SMOKED PRINCE ALBERT IN IT

YES, ROB, AND THAT FIRST PIPEFUL CERTAINLY OPENED MY EYES TO THE REAL PLEASURE IN PIPE SMOKING

Copyright, 1938, R. J. Reynolds Tobacco Company

THEY'RE ALL MEMBERS OF THE
PIPE-JOY CLUB

I THINK I'M ENTITLED TO A LITTLE FUN OUT OF LIFE, SO I TREAT MYSELF TO **EXTRA-MILD SMOKING—NO-BITE PRINCE ALBERT**

I CAN PICK AND CHOOSE AMONG TOBACCOS, BUT IT'S PRINCE ALBERT FOR ME. THE **CRIMP CUT** ASSURES EASY DRAWING, AND **MELLOW SMOKING!**

THERE'S A LOT OF COMFORT IN A PIPEFUL OF **GOOD, RICH-TASTIN' PRINCE ALBERT**. P.A. SURE IS A BARGAIN AT THE PRICE

CLERK **BROKER** **MECHANIC**

MONEY-BACK GUARANTEE
Smoke 20 fragrant pipefuls of Prince Albert. If you don't find it the mellowest, tastiest pipe tobacco you ever smoked, return the pocket tin with the rest of the tobacco in it to us at any time within a month from this date, and we will refund full purchase price, plus postage. (Signed) R. J. Reynolds Tobacco Company, Winston-Salem, N. C.

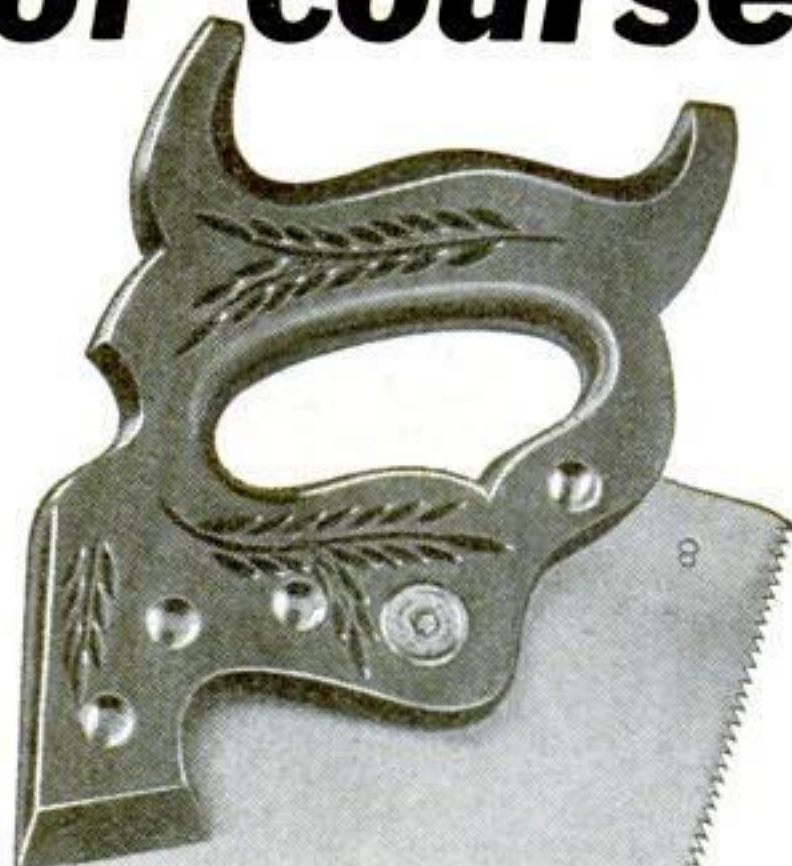
PRINCE ALBERT
THE NATIONAL JOY SMOKE

PRINCE ALBERT
CRIMP CUT
LONG BURNING PIPE & CIGARETTE TOBACCO

THE BIG **2** OUNCE RED TIN

SO MILD

DISSTON —of course



time to buy a new Hand Saw

Enjoy the treat of a finer saw than most men have ever owned! Ask dealer for DISSTON D-23. Lightweight, straight back, narrow blade. Butt, 6 3/8"; point, 1 1/2". Precision balance, true taper, easy running, fast cutting. Disston's world-finest saw steel. Mirror polish, striped back, beautifully etched. Applewood handle, full carved. Cross-cut or rip. One of Disston's finest, 26" length for only . . . **\$3.85**

Ask your dealer also to show you DISSTON D-8,

world-famous as the "Saw Most Carpenters Use". Skew back, 26" length, **\$3.50**. Also made Lightweight Pattern for home workshop **\$3.50**

FREE MANUAL



How to Choose and Use Saws—answered in "Saw, Tool and File Manual". FREE. Mail this to Henry Disston & Sons, Inc., 310 Tacony, Philadelphia, U. S. A.

Name _____

Address _____

Check the Hardware Store for Value and Variety

Drab-Colored Shops are Out!

(Continued from page 91)

because such very dark colors may readily absorb up to 47 percent of the active light entering such areas. Sash should preferably be painted white or ivory.

The five-foot dado, or lower wall panel, may be a light tan or green, preferably on the gray-green or jade-green side for softness and to kill the very appreciable but generally ignored "ground light" reflected upwards to the eyes of machine operators. This ground light may be a definite accident hazard.

ALL starting equipment, clamp-rack knobs, machine-table edges, and guards should be painted a bright red or scarlet. This becomes doubly effective on machine-table edges when they carry a narrow stripe of bright yellow along the center of the red.

The bodies of all machines may be a light to medium chrome green. For this use white oilproof machine enamel shaded to a light ivory by stirring in a slight amount of French ochre ground in oil; then shaded light pearl gray by adding a trace of black enamel; then to a soft, bright shade of jade green by adding medium chrome green in oil. If five gallons or more are needed, any reputable paint manufacturer will make up a jade-green machine enamel to suit.

Again, the machines may be a soft, light straw or tan, trimmed with bright green and scarlet. Avoid heavy, deep colors as they are as deadly as the customary black and "machinery gray," which make the shop dull and dreary.

In most cases the machines have been painted by the manufacturer on frames well filled, puttied, sanded, and surfaced before applying the enamel. Where long service or hard usage has chipped or dented the surface, the machines must be serviced before painting. Wash with a trisodium-phosphate solution, using 1/2 lb. of powder to a 15-qt. pail of hot water. Rinse well, then wipe down with rags saturated with denatured alcohol to remove the last traces of grease, especially in the neighborhood of bearings. Do not use gasoline because this would spread a layer of oil over the entire surface and destroy adhesion.

Apply a coat of sanding surfacer sold by the manufacturer of your machine enamel and handled according to directions on the can. Let dry hard, then putty up all dents, chips, and rough areas, using a putty-knifing glaze applied according to directions. Dry hard; the time will vary with the glaze.

A glaze can be made by hand from one third white lead paste in oil, two thirds dry whiting, and enough machine enamel to make it work smoothly under the glazing knife.

When the putty has dried hard, sand the entire job smooth and level with 2/0 waterproof abrasive paper and water. Wipe clean and let dry. Apply a second surfacer coat if desired.

The enamel may then be brushed on or sprayed. Let the enamel dry hard enough to resist thumb-nail pressure, then apply a second coat.

How to Be Your Own Ski Repairman

(Continued from page 81)

both surfaces and when dry, glue them together under pressure. Make certain that the grafted tip is straight.

I do not recommend repairing broken bindings, and poles cannot be satisfactorily repaired once broken. Such parts as the snow ring and tip are easily replaced. The handle generally stays on the pole as long as the pole lasts. A split pole can be safely taped with friction tape, providing it is split on one side only.

When the skiing season is over, remove all the running wax with the scraper and some gasoline or benzine. Recondition the running surfaces with pine tar or lacquer as described in last month's article.

If the skis have developed a twist, they should be straightened by strapping or clamping them to a thick board with a small block under the lower side of the twist. A plank shaped to the form of the ski, as illustrated in one of the photographs, is convenient but not always necessary. Then when the skis are in first-class condition, put them in a press.

A ski press consists of two clamps, a block, and a spreader. Each clamp is made of two pieces of wood 1 by 1 by 6 in. fastened together with bolts and wing nuts, one at each end. The bolts should be about 2 1/2 in. long and 3/16

in. in diameter. The block is 1 by 2 by 3 in.; the spreader is 1 by 1 by about 8 in. with sharp ends, like pencil points.

Place the skis with the running surfaces together and attach the lower clamp about 4 in. from the heel of the skis. Then place the block between the skis under the toe irons so there is a 2 in. space, and fasten the second clamp where the skis touch when pressed together. Insert the spreader between the tips. To keep it in place, drill small, shallow holes 1 in. below the tips.

Put the skis in a place that will not be too hot and dry, or too cold and damp. A happy medium is best. Stand them on their ends, not tips, or lay them down flat.

Rubber Treads Lengthen Life of Overshoes

RUBBERIZED overshoes and boots often wear completely through the rubber sole and heel and have to be discarded although the uppers are in good shape. Never wait that long. As soon as the original tread is worn smooth, purchase a ten-cent pair of rubber repair soles and cement them in place. A smaller pair can likewise be cut up and fitted to the heels, if necessary. These soles supply a new tread, which is an aid to safety in icy weather.—GAIL FOSLER.

Old
Bill

SAYS:



LATHE mandrels of large diameter should be made from machine steel and left soft for the sake of economy. Hardened tool-steel centers in the form of inserts should, however, be pressed into holes drilled in the end of the mandrels. Each mandrel, of course, should be finish turned to size while running on the inserted centers.

The cost of metal castings and the necessary patterns has often deterred embryonic inventors and model makers from attempting projects. Local welding shops can now approximate almost any metal casting at moderate cost by fabricating sheet metal, machined parts, and structural sections.

When it is necessary to cut thin sheet rubber into suitably shaped pieces for gaskets and other necessary parts, apply glue to the entire surface of the rubber and fix to a piece of sheet metal, being careful not to stretch it in the process by applying too much pressure. After the rubber has been cut with a razor blade or a very keen, thin knife, it may readily be stripped from the sheet metal. Rubber is much easier to cut if the blade is first dipped in water.

When the hole in a pulley or gear, which is to be keyed or pinned in place on a shaft, is too large, cut a spiral groove through the hole by utilizing the thread-cutting lead screw of the lathe, and then tin the hole. The purpose of the spiral groove is to anchor the solder.

In making blanking dies, it always pays first to make a template the shape of the desired blank. The template can be used for gauging purposes when filing the die. A knurled handle attached to the center of the template will be found convenient.

It isn't necessary to clutter up the tool box with every size drill and tap, if the necessary taps, tap drills, clearance drills, and counterbores for each commonly used tap size are kept together in units by mounting them in suitable wooden blocks, one block for each thread size.

Crackle-finishing paint can be applied when necessary without special equipment. Even the oven of a kitchen gas range will answer the purpose. When patching work too large to be accommodated by the oven, apply the special crackle-finish paint to the desired spot and cover it with a tin can containing a 100-watt electric light.

To determine the accuracy of a lathe lead screw, disengage it from the gear train and secure it in place by pinning. Now place a piece of round stock between centers and cut a series of annular grooves in it by engaging the lead screw nut at each successive pitch. The distance between the annular grooves cut in the test piece indicates the lead and pitches of the lead screw.

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If, however, you prefer to build models, furniture, or countless other articles, you will still find our Blueprint Service Department ready to help you. A partial list of plans is given below; a complete list will be sent upon receipt of a stamped, self-addressed envelope.



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(Construction kits are available for some of these models. See page 28.)



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Broken Pipe Repaired with Inner Tube

WHEN a water pipe breaks in a place where the leaking section cannot easily be replaced, one way to make a temporary repair is to wrap the pipe with wide strips cut from an old inner tube. Stretch the tube as tightly as possible, and tie it securely with twine. This repair can be made permanent if conditions permit a cement casing to be cast around the pipe so as to cover the wrapped section and extend a short distance beyond.—THOMAS M. MCCORD.

Cigarette Wrapper Protects Watch in Dusty Factory

A WATCH or other small, delicate instrument may be protected from dust and moisture when necessary by using the transparent wrapper from a package of cigarettes. Remove the wrapper carefully, place the watch in it, and twist it shut around the stem. This has proved a satisfactory expedient in a dusty factory.—ERIK H. DUFFY.

Laying Model Track

(Continued from page 82)

16½ millimeters from the first. Check frequently to see that this gauge is maintained throughout.

On curves, you will have to cut the ballast material to shape. The tie strips are easily bent by taking a pair of scissors and cutting away all the connecting links on one side. On curves, use the track gauge so the side with two notches is on the outside of the curve; this will automatically increase the gauge slightly, to give the locomotives and cars extra freedom on the turn.

Holes are provided in the tie strips for inserting the third-rail supports. Tack them in, then solder the square brass strip to their tops.

Even the task of soldering the third rail straight on the nailheads may be avoided if you are willing to go to a little extra expense and buy third-rail chairs. These are turned brass supports, drilled and counterbored so that they can be nailed in place. Across the top is a slot into which the third rail fits.

Joints in the rails may be left unconnected if desired, but they should then be spiked up close to the end to keep them in line. If you prefer, you may use small U-shaped fishplates that slip over the bases of the rails and keep them in line. These should be tightened with a pair of pliers. In either case, the third rail and at least one running rail should be bonded electrically to provide a path for the current. This is done by soldering connecting links of wire across the end of the rails as shown. If you use roofing-paper ballast, put a piece of sheet metal or fiber under the joint while soldering to prevent the heat of the soldering iron from melting the tar in the ballast.

The construction of switches and suggestions on planning a layout will be given in a following article.

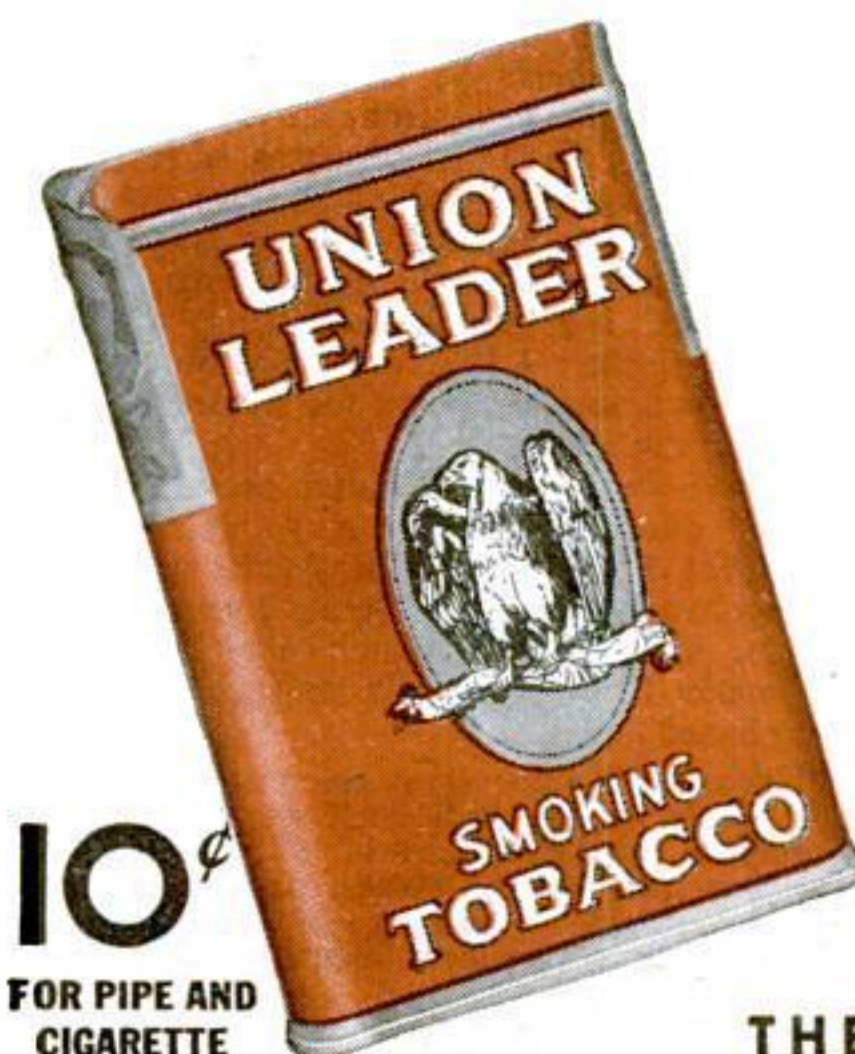
A Loyal Friend Then...and Now

IN 1905 . . . "I was 30 when I got married. My wife, Nellie, said she liked to see a man smoke a pipe, so I took up with it. At first I didn't like it much, but after trying a lot of tobaccos I discovered UNION LEADER, which I found real pleasurable and stuck to ever since."

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Union Leader



ALWAYS . . . Since the day it was introduced, over a third of a century ago, UNION LEADER has been a true friend of pipe lovers. This prize Burley from the Kentucky Hills is mellowed in oaken casks and made bite-free by a special process. Try a tin today—the biggest money's worth of smoking pleasure a dime ever bought!

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The 'Alabama,' Confederate Raider

(Continued from page 89)

Waterways are strips 1/16 by 3/32 in. glued to the deck in the corner between bulwark and deck. They run along both sides from poop to forecastle.

For the poop and forecastle bulkheads, I used thin pieces of 1/8-in. gumwood on which are carved the paneled doors and windows. The door panels are painted white, the windows blue. The bulkheads are glued in position against the ends of F and G. The joint is concealed by gluing a covering board along the edge of the deck above, a scant 1/16 by 5/32 in. Each covering board should project slightly over the edge of the bulkhead.

There were probably port lights to

the poop and forecastle, placed as shown last month on the sheer plan. These I indicated by cutting slight depressions in the hull 3/32 in. in diameter, and painting them blue to represent glass.

The pinrails also can be seen on the small deck plan. They should be a full 1/16 in. thick by 3/16 in. Nail them firmly to the bulwarks.

The decks should be lined to represent planking. A very sharp, hard pencil will do this. Lines from 1/16 to 1/10 in. apart look best.

Painting the hull is of the utmost importance, although oftenslighted by beginners. The wood should be made perfectly smooth with progressively finer grades of sandpaper, then dusted and

given a very thin coat of shellac—one part shellac to two parts alcohol.

Two or three coats of flat white should next be applied. Each must be allowed to dry thoroughly and be rubbed down with No. 00 or finer sandpaper between coats. Any inequalities or scratches will then become visible, and they should be eliminated. My preference for a putty for such small work is paste wood filler, obtainable at any paint store. Plastic composition wood is also a valuable aid.

Up to the water line the hull is painted to imitate copper color. For this I have found that burnt sienna and Indian red oil colors of the type used by artists and sold in tubes are better than a metallic paint. Some emerald green is rubbed in at the bends and here and there where the verdigris might be expected to cling. One coat is sufficient.

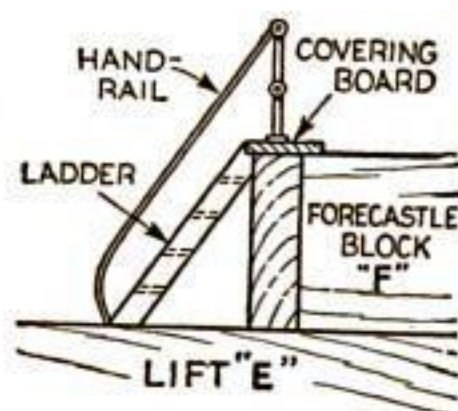
Some model makers may prefer to sheath the hull up to the water line with real copper. If so, the method given for the models *Hartford* and *Great Republic* may be followed (P.S.M., Dec. '35, pp. 95 and 96, and Jan. '34, p. 86; also, *Manual of Ship Model Making*, p. 36).

From the water line up, the hull is black. Inside, the bulwarks are white. The decks should be lightly varnished over the pencil-marked planking lines, and the bright work more heavily varnished.

(TO BE CONTINUED)

Striping Ship Models Neatly

CELLULOSE tape of the nondrying adhesive type may be used for applying neat stripes and water lines to ship models. Cut off a sufficient length and stick it to a pane of glass. Paint it the desired color (unless you can obtain tape of the exact color needed) and, when the color is dry, slice the tape into the required width with a straightedge and razor blade. You can then strip these narrow slices from the glass and stick them on the model. Finally, apply a thin coat of varnish.—CURTIS WARD.



Cross section of the forecastle bulkhead

MATERIALS FOR FITTINGS OF THE 'ALABAMA'

SOFT PINE

No. Pc.	Dimensions	For
1	1/2 x 3/4 x 13 1/2	Lifeboats, skylight
GUMWOOD OR OTHER SEMIHARDWOOD		
1	1/8 x 1/8 x 12	Catheads, fife rails, etc.
1	1/8 x 3/16 x 20	Knightheads and channels
1	1/16 x 3/16 x 20	Pinrails
1	1/8 x 1/4 x 13	Hatches
1	3/32 x 1/4 x 6	Gaff jaws, etc.
1	1/8 x 3/8 x 8	Funnel casing
1	1/16 x 7/8 x 1 1/4	Top of funnel casing
1	1/32 x 3/32 x 12	Ladders
1	1/4 x 5/8 x 6	Gun carriages, etc.
1	7/16 round x 3/4	Capstan
8	1/16 " x 6	Spars
3	1/8 " x 18	Masts, spars
3	3/16 " x 18	Masts, spars, guns
2	1/4 " x 18	" " "

MISCELLANEOUS

Fiber or celluloid 1/16 x 3 x 3 for caps and tops.
Brass tubing: 1 pc. 1/2 outside diameter x 2 for funnel; 1 pc. 3/32 outside diameter x 3 for steam pipes.
Sheet brass: 1/64 x 1 x 3 for mast and yardarm bands, pintles, gudgeons, etc.; 1/32 x 1 1/2 x 6 for bridge, standards, propeller galleys, smokestack bands, etc.
Brass rod 1/8 x 3 for binnacle, trusses, propeller shaft.
Wooden grating 1 x 3.
Stanchions: 26 turned from wood, 1/4 in. long; also materials for making 31 metal 2-ball stanchions 1/4 in. long (or the stanchions may be purchased ready-made from a dealer in ship model supplies).
2 steering wheels 1/2 in. outside diameter (to be made or purchased).
Wire: 3 ft. No. 18 for trusses, sheerpoles, dolphin striker, whiskers, etc.; 10 ft. No. 24 for grating bars, jackstays, ladder handrails, chain plates, etc.; 20 ft. No. 28 for stanchion railing, deadeye straps, etc.; 4 ft. No. 30 cotton or silk-covered magnet wire for footropes and stirrups.
Bell 1/8 in. high; 4-bladed propeller, 7/8 in. diameter; 6 mooring bitts 1/2 in. long; 5 pair of 1 1/2-in. davits with side sockets and rail brackets; 2 anchors 1 1/2 in. long (all of which may either be made from scraps of material or purchased).

NOTE: All dimensions are in inches. The materials for the hull itself were given in a previous list (P.S.M., Feb. '38, p. 80). The rigging line, chains, blocks, and other materials required for rigging the model will be itemized in a later installment.

Leaky Gutters Repaired with Roll Roofing

WHEN wooden or metal eaves gutters leak, they may be lined with a strip of composition (roll) roofing. The strips should be cut to fit snugly and bent to conform to the shape without wrinkles or buckles. If laps are made, be sure that the strips are laid so that the water flows over the lap.

Coat the inside of the gutter with "lap cement," asphalt emulsion, or hot asphalt, and use sufficient nails (if the gutter is of wood) to insure a permanent job. Do not drive any nails into the bottom of the gutter except where there is a lap or double thickness of roofing.

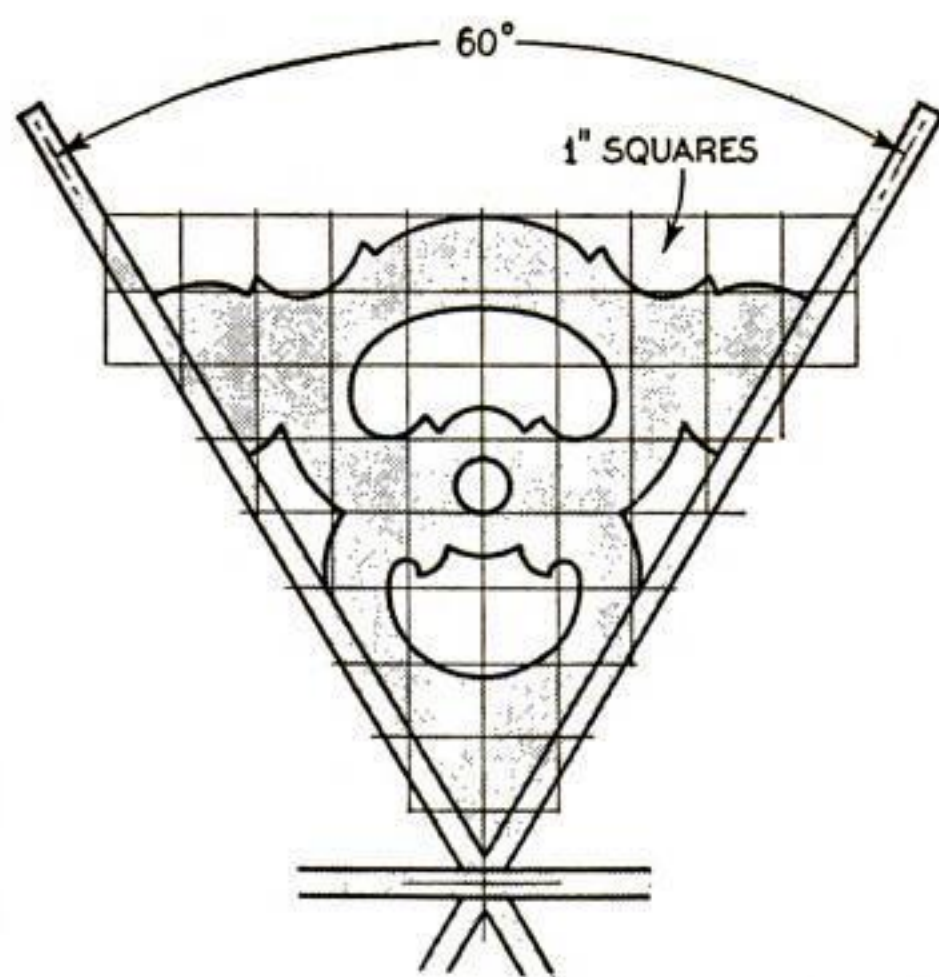
It is a good plan each year when cleaning out the repaired gutters to give the lining a coating of high-grade asphalt roof coating. This treatment will extend the life of the gutters indefinitely. Water conducted through the gutters to a cistern may be used for all domestic purposes without taint or taste of any sort.—W. W. WHEATLY.

A Rack for Magazines

(Continued from page 79)

clips of thin sheet metal placed as in the sectional detail A-A.

Solid maple, walnut, or mahogany may be used, either $\frac{3}{8}$ - or $\frac{1}{2}$ -in. thick. Plywood is structurally better, but is sometimes hard to obtain it faced with hardwood on both sides, as required for this job. Suitable panels, however, may be easily and cheaply made up in your



Layout for the twelve end sections of the rack. Several may be scroll-sawed at once

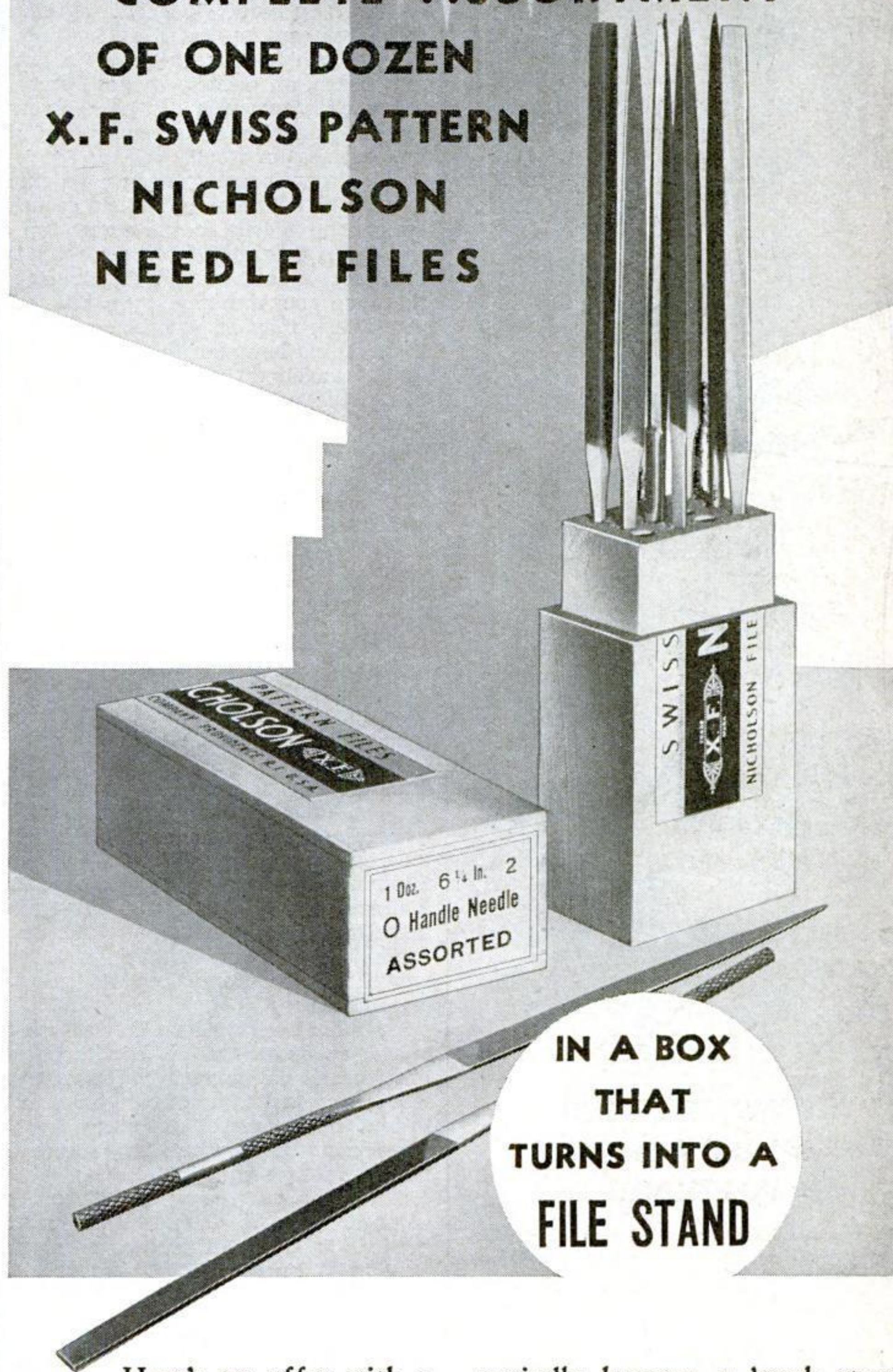
own shop by facing $\frac{3}{16}$ - or $\frac{1}{4}$ -in. thick basswood or fir plywood with veneer.

Labor may be minimized by bradding several end pieces together and cutting them out at one time on the scroll saw.

If plywood is used, paint the edges with filler mixed with the desired stain and some varnish. Rub the filler in thoroughly, and after it is dry, sand to a smooth level surface.

A U-shaped metal or wood strip, as suggested in detail C, will serve to protect the two feet.—D. P. ASBURY.

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Fixed-Focus Enlarger

(Continued from page 104)

of negatives. This carrier also protects the film from heat and scratches.

Materials required include a tall, 1-lb. coffee can for the lamp housing, a smaller can for the "bellows," a printing frame, an electric socket flange, a key socket, two strips of glass, ground or opal glass, hinges, screws, bolts, and a few pieces of wood.

The lamp housing should be made first. The socket may be held securely by cutting a hole in the screw top of the coffee can slightly larger than the diameter of the socket, and soldering a threaded socket flange over this hole. The flange may be bought or removed from an old lamp shade. Drill eight $\frac{3}{8}$ -in. holes around the top of the can, just below the cover ring, for ventilation. Light from these holes is diverted by a sort of balcony made of two rings cut from tin cans and soldered together as shown, or from the bottom section of a larger can.

Next make the negative carrier, which consists of two glass strips, $1\frac{3}{8}$ by 10 in., cut from an old glass photographic plate or picture glass. Put a negative between them, press tightly together, and bind them along one of the long edges with a strip of $\frac{1}{2}$ -in. photographic adhesive tape. Slight heat will cause the tape to stick more firmly.

THE exact spacing of the negative, lens, and printing paper, must be determined by experiment. For a 2-in. lens, arranged to enlarge a double-frame 35-mm. negative to $2\frac{1}{4}$ by $3\frac{1}{4}$ -in., the distance will be roughly 3 in. from negative to center of lens, and 7 in. from center of lens to paper. A 3-in. lens would require proportionately greater separations.

By mounting the lens on stiff cardboard, as shown in one of the photographs, and manipulating it so that the image of a test film is projected sharply and to the correct size on an improvised easel, the proper distances may be accurately found.

These known, the remainder of the enlarger may be planned and put together. In the enlarger illustrated, the base is $\frac{3}{4}$ by 6 by 7 in., and the upright, also made of $\frac{3}{4}$ -in. stock, is 16 in. high.

The can for the bellows should be about 3 in. in diameter and about $\frac{1}{4}$ in. shorter than the distance required between lens and film. The top of the can should be cut out completely, and a hole cut in the bottom for mounting the lens.

The mounting for the negative carrier may be made either from two disks of wood with spacers between them, as shown in the drawing, or by building up a similar arrangement from disks of cardboard glued together under pressure. Cut the rectangular holes about $\frac{1}{4}$ in. longer and wider than the film frame to be used. The spacers should be just thick enough that the negative carrier, with film in it, will

(Continued on page 115)

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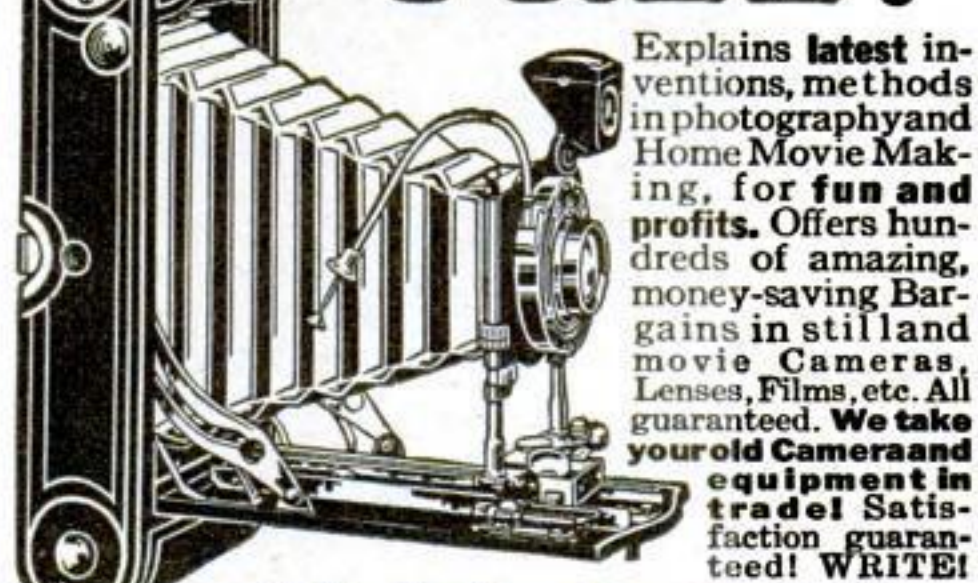
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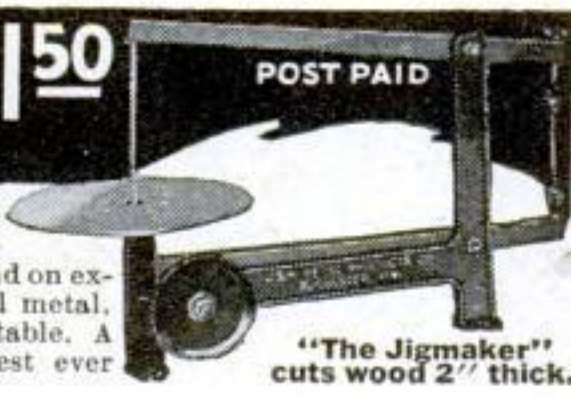
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Liquid Rubber Repairs Camera Bellows

WHEN pinholes appeared recently on numerous folds of the bellows of my 5 by 7-in. view camera, I was confronted with the problem of patching them or buying a new bellows. The usual procedure is to apply adhesive plaster, but there were too many pinholes for that, so I tried what is known as "liquid rubber." This compound is essentially black rubber dissolved in a solvent, and it is obtainable in many ten-cent stores. I painted each worn corner of the bellows with this compound, and when it dried, found that the camera was once more lightproof. Although the camera is in constant use, the repair has proved permanent.—TRACY DIERS.

Fixed-Focus Enlarger

(Continued from page 114)

pass through without binding. Any slight miscalculation of focus may be compensated for, after the bellows can has been fastened, by moving the mounting in or out of the top of the can before screwing it into place.

A printing frame of the required size, hinged at its back edge to the baseboard, comprises the easel. The regular back of the frame should be discarded, and a wood rectangle of the same size is screwed to the baseboard. It should be thick enough to hold a sheet of printing paper firmly when the frame is lowered over it. During printing, the frame is held down by a little clip cut from spring brass, having a hole in it which engages a brad head projecting from the frame.

The bottom of the wood upright fits tightly into a recess cut for it in the baseboard. An angle iron on each side helps steady it. The bellows is centered under the lamp housing by means of a block of wood between it and the upright. Four carriage or stove bolts, with washers under their nuts, hold the two cans securely in place. The upper can need not be fastened to the carrier mounting.

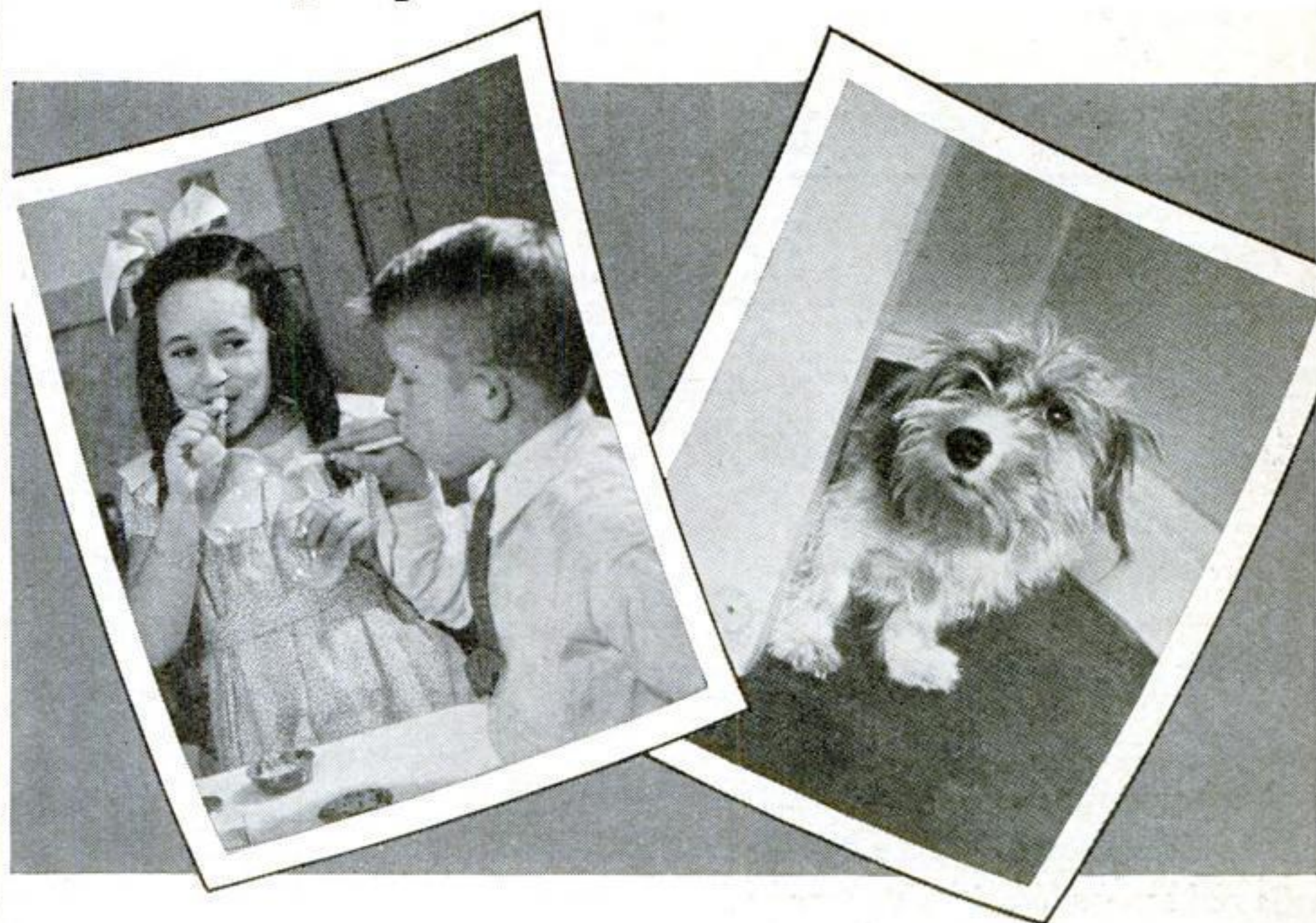
The light from a 60-watt (a larger lamp is not recommended) frosted bulb is diffused by a sheet of ground or opal glass laid over the hole in the bottom of the lamp housing. If one sheet does not diffuse the light sufficiently, another sheet should be arranged about $\frac{3}{4}$ in. above the first. Support it with a ring of tin.

Paint the interior of the lamp housing with several coats of flat white, thinned a little with turpentine. The top surface of the rectangle of wood in the printing frame also should be flat white because it will help in centering the negative. The interior of the bellows can and the inner surfaces of the rings around the heat vents on the lamp housing are painted a dull black.

If all distances have been carefully measured and the lens, negative-carrier holder, and easel exactly aligned, the enlarger will always be in perfect adjustment.

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Old English CEMENT

Building a Basement Game Room

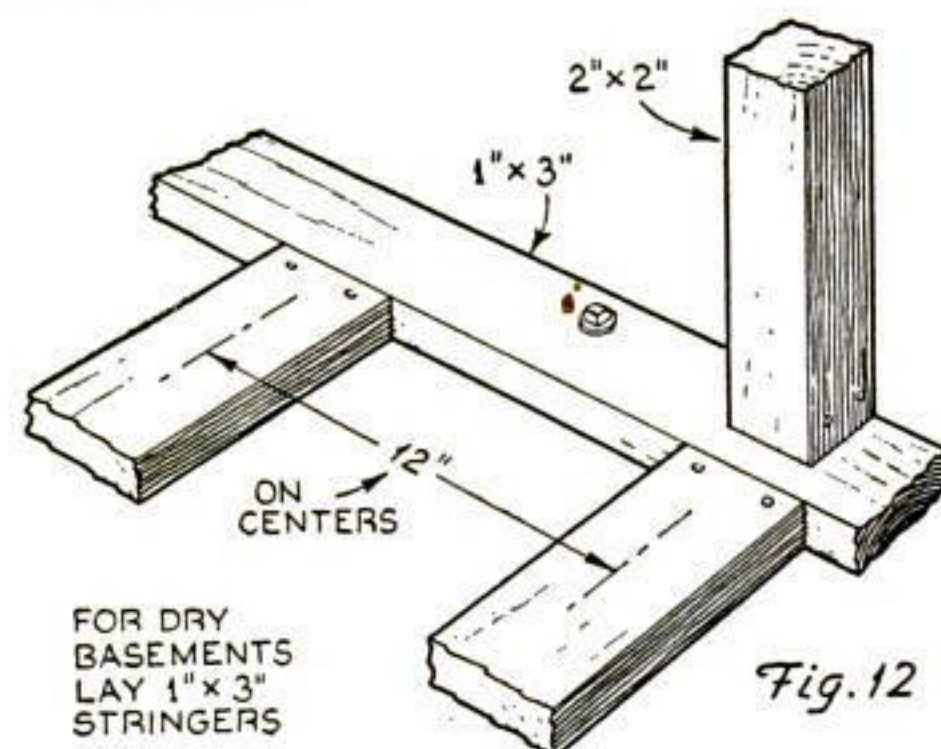
(Continued from page 86)

usually large enough—are erected on the sills, toenailed at the bottom, and nailed at the top to the floor joists above. Wall board or $\frac{1}{4}$ -in. plywood is then nailed to the studs, and the seams are covered with $\frac{1}{4}$ by 1-in. battens. This gives a clean, paneled effect.

Window openings are trimmed with suitable material, depending upon the paneling, baseboard, and cornice chosen. For a simple job, $\frac{3}{4}$ by 4-in. pine, mitered at the corners, will be satisfactory. The sectional view in Fig. 11 illustrates complete details of wall and floor construction.

A raised wood floor is almost imperative where there is any likelihood that water will seep into the basement during heavy rains. In any case limber holes, or notches, should be cut in the bottoms of the joists to permit water to flow off to the regular drain, and also to provide ventilation.

If the basement is always dry, cheaper joists or stringers can be used as in Fig. 12. This does not leave much space between cement and floor, but is sufficient for warmth, especially if tar paper



Cheaper floor stringers for dry basements

last treatments, however, require outside help to do a satisfactory job.

In a following article suggestions will be given for dressing up game rooms with built-in fittings, fireplaces, novel stairway treatments, scenic windows, and refreshment bars.

Inner Tube Protects Arm When Cleaning Furnace

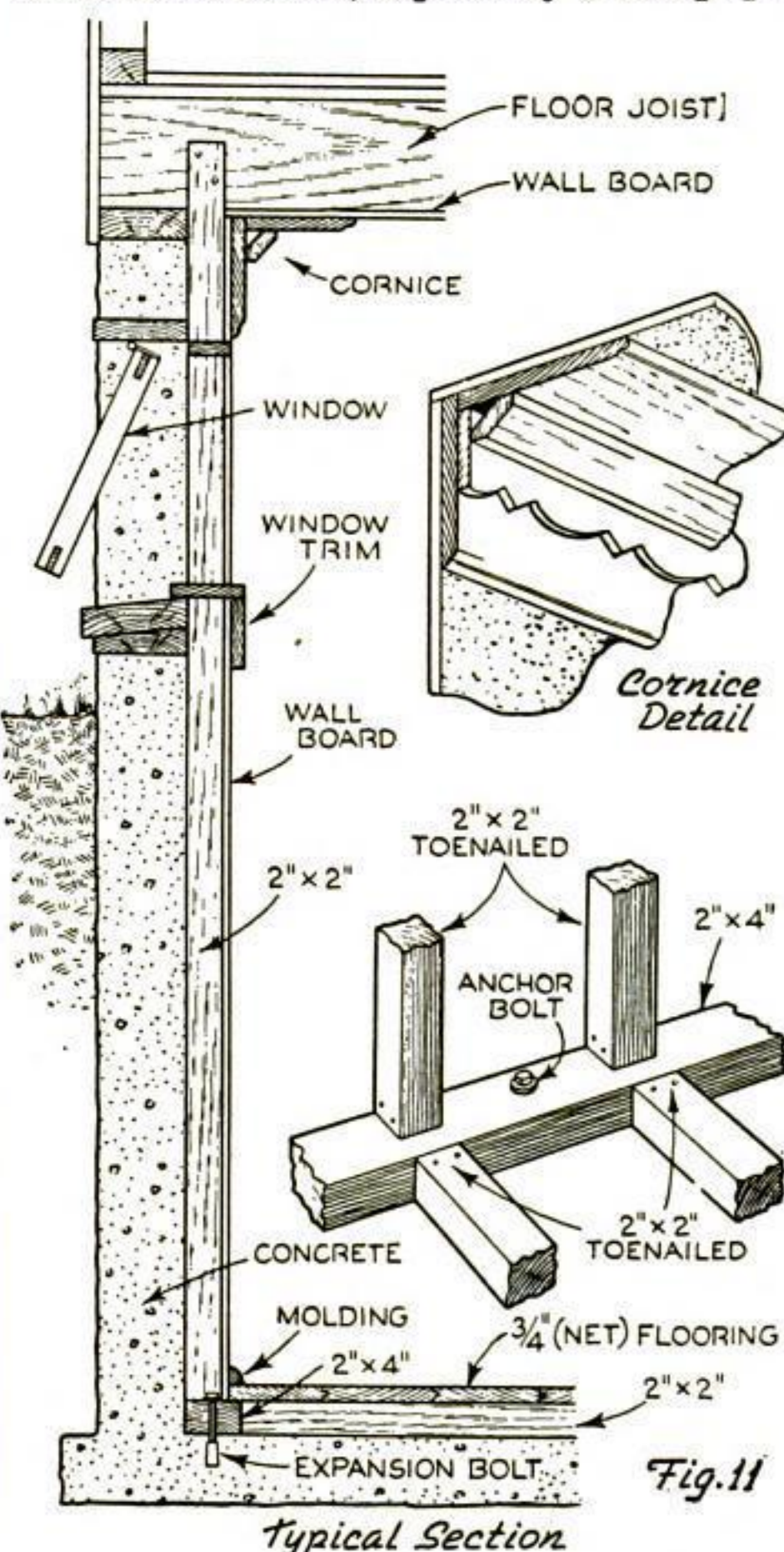
RECENTLY, when I found it necessary to remove dust and ash from the radiating chamber of my warm-air furnace, I cut a section from an old inner tube long enough to fit my arm and shoulder. After it had been drawn on, the wrist portion was tightened by rubber bands. The curve in the tube adapted itself to the arm when bending to reach into the clean-out, and it was possible to brush and scrape as much and as long as necessary without being scratched or soiling or tearing my shirt.—JACK WELLS.

Fruit-Jar Rings Stop Leak at Bathtub Overflow Pipe

A SLIGHT but persistent bathroom leak, which baffled a plumber and resulted in several repair bills, was finally discovered to be due to the fact that the tub had sunk a little and the overflow pipe on the tub no longer fitted perfectly flush. This permitted water to leak past the rubber gasket whenever the tub faucets were turned on full and some water was flowing through the overflow pipe. The difficulty, once found, was corrected in a few minutes by placing five ordinary fruit-jar rings between the end of the tub and the overflow pipe.—O. E. ABERNETHY.

Reinforcing Magazine Covers

BACK issues of POPULAR SCIENCE MONTHLY, which I make a practice of saving, are handled so much that the covers are likely to fall off in time. To prevent this, I place a piece of narrow adhesive tape about $1\frac{1}{4}$ in. long across the back at the top and the bottom, lapping over the covers for about $\frac{1}{2}$ in. If the covers start to tear at the fold, these bands check the tear from continuing.—S. MORTON DECKER.



Cross section showing the wall and floor construction, and two explanatory sketches

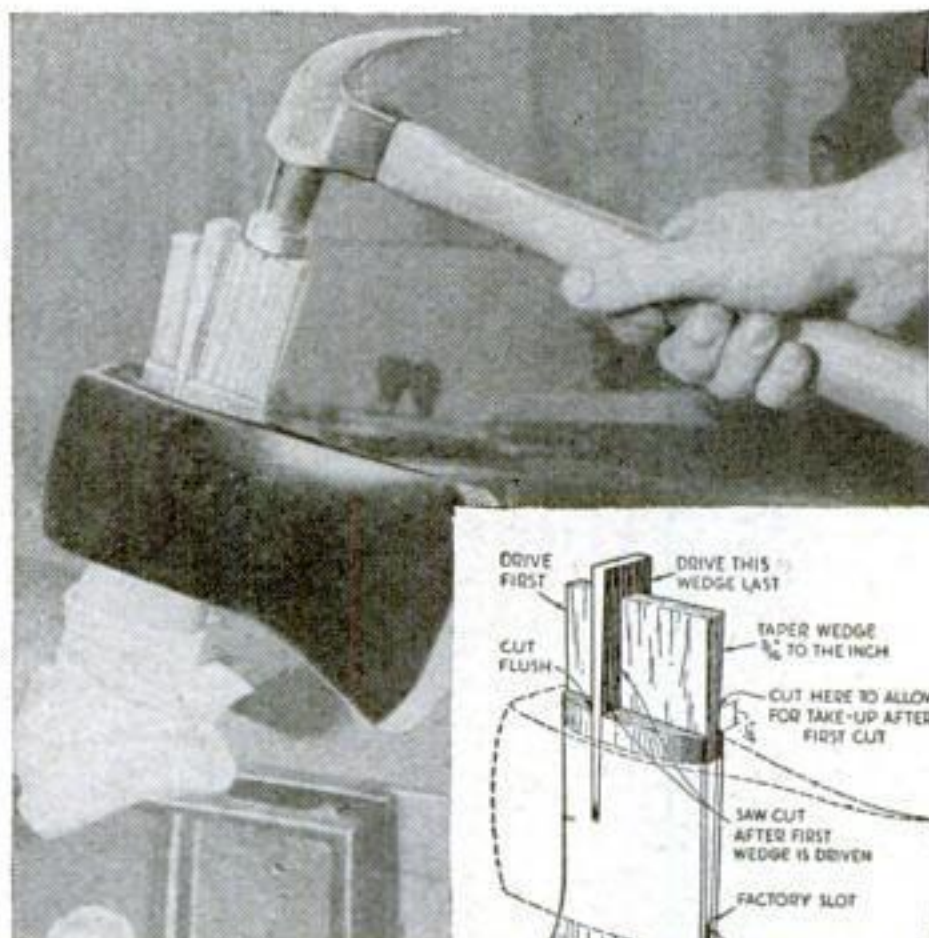
is used beneath. The wood floor is much more satisfactory than painted cement, the latter being rather cold, even if linoleum or rugs are used.

A type of wood block is now available that can be cemented directly to the concrete, and also a composition tile intended to be laid in tar. These two

Wedging an Ax Handle to Hold Securely

IF AN ax helve breaks—or a hatchet or hammer handle, for that matter—it is important to know how to wedge a new handle so that the head will stay on and so that the “hang” suits your personal preferences. In fact, even with a new ax it pays to buy the head and the helve separately and fit them to your own taste, provided you have had sufficient experience with an ax to know exactly what you prefer.

The helve must be well-seasoned, thoroughly dry, and so straight-grained that at least some of the grain may be



Ax heads stay on if wedged in this way

traced from one end to the other without interruption. For the wedges, spruce or other well-dried, tough wood will serve. Cut them with a taper of about $\frac{3}{16}$ in. to the inch and with the starting edge thick enough to prevent its being pushed into the saw cut more than $\frac{1}{4}$ in. by hand.

The helve is left $\frac{1}{4}$ in. longer than the width of the head at the eye. Do not saw it off flush because the projection provides an extra clinching effect to the wedging.

With a maul or a piece of plank, drive the first or large wedge snugly in the usual position—that is, corresponding to the long axis of the helve. Then make a saw cut as shown in the diagram through the projecting part of the wedge and down into the helve, and start a thin wedge at right angles to the first wedge. The second wedge is a very important item as it prevents “rocking” and subsequent loosening of the head. After driving this second wedge with a hammer, cut it off at the end of the protruding helve, but be careful to leave the first wedge protruding about $\frac{1}{4}$ in. from the helve to allow for future tightening after the ax head has been in use.

Always keep the helve dry, because alternate drying and wetting will loosen the head. As a further safeguard, I give the helve several coats of well-thinned paint, which is carefully worked into any crevices between the head and the helve.—ARTHUR E. MAC NEILL.

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New Sports Records Set by Science

(Continued from page 39)

in making which the athlete approached the bar at an angle of thirty-seven degrees, gave his feet twice the momentum of his head as he left the ground, and literally rolled over the bar with a series of body contortions in mid-air.

CAN jumpers go still higher than today's stars? Prof. A. V. Hill of London University, England, suggests a way. Watch a high-jumper clearing the bar, and you will see that his body is practically parallel with it. He is trying to keep his center of gravity as low as possible because it is the effort of lifting this imaginary midpoint of his body's weight—about three feet from the ground when he is standing erect—that limits the height of his leap. "Paradoxical as it may seem," Prof. Hill now proposes, "it is possible for an object to pass over a bar while its center of gravity passes *beneath*." By skillful acrobatics, he points out, an accomplished high-jumper might snake his body over the bar like a rope going over a pulley, so that he would not have to expend the effort to lift his center of gravity to its level. Scientifically minded athletes may take the hint and set still more astounding records.

Likewise, in pole-vaulting, scientific technique has made good. As this issue went to press, Judge Samuel E. Hoyt, president of the Amateur Athletic Union, predicted that 1938 would see the dream of a fifteen-foot pole vault come true. Followers of sport would have been startled, not so long ago, to see any pole-vaulter soar thirteen feet into the air. Last year at Los Angeles, Calif., officials set the bar as high as the supporting posts permitted it to be raised—fourteen feet and eleven inches above the ground. Two veterans of our 1936 Olympic team, Bill Sefton and Earle Meadows, zoomed over it! Pick up a pole in your back yard and try leaping in your second-story bedroom window—or, better, just imagine it—to get an idea of those jumps. A pendulum swing, an upside-down arch of the body, and perfect timing, with a birdlike flight after releasing the pole, have shattered records that were thought unbeatable.

AN AVERAGE man who can jump over a tennis net is apt to consider himself pretty agile. Think of leaping over ten wooden standards of the same height, in the course of a 120-yard race, and you will have a good mental picture of the classical high-hurdles event that Capt. Robert D. Osgood, of Lakewood, Ohio, last year became the first man in history to negotiate in fourteen seconds flat.

Along with the performances of other modern hurdling stars, his amazing achievement springs from the recognition of the scientific fact that hurdlers travel faster on the ground than in the

(Continued on page 119)

air. Earlier athletes skimmed the hurdles in more prolonged and graceful arcs, but lost precious fractions of seconds before their feet could obtain traction again. Today a hurdler goes straight-legged over the barrier, whipping over his trailing leg with a lightning-fast snap to get back to earth as quickly as he can, and new records are the result.

If these seem stunts for athletic competitions rather than for everyday use, consider swimming—where speed and endurance may save your life or that of a drowning friend. No better illustration of a revolutionary change brought about by scientific technique could be found.

THREE years ago, seventeen-year-old Ralph Flanagan of Miami, Fla., learned a brand-new swimming stroke invented by his coach, Steve Forsyth. In the first three months that he used it, the youngster broke twenty-five speed records. Today, at twenty, he ranks as America's champion distance swimmer. Sports experts hail his phenomenal mile in the world's-record time of twenty minutes, forty-two and six tenths seconds, as the sensation of men's swimming in 1937.

The new stroke, a modification of the American crawl, reduces arm movements by a third. Giving more perfect balance and relaxation, it enables a swimmer to cover distances with far less effort. The head and shoulders of the swimmer remain level with the water. Roll is minimized, and the body is propelled on an even keel. In the technical language of a swimming instructor, the innovation in the Forsyth stroke consists of a two-kick glide between pull and recovery, while the conventional crawl simply employs three kicks for recovery and three for pull.

Stretched across a bed and waving his arms and legs, one summer day in 1934, Forsyth devised the stroke in an effort to improve the swimming speed of Peter Lehman, seventeen-year-old son of the Governor of New York State. It worked, and Flanagan, who learned the stroke in five minutes' time when it was explained to him, demonstrated it to be the first major improvement in swimming in decades.

DID the inventors of skiing learn it the wrong way? So Emile Allais of France, world's champion skier, maintains. According to his system of skiing instruction, which has just been officially adopted by the French Ski Federation, it is worse than useless to teach the famous "Telemark" turn—named for the very district in Norway where, three-quarters of a century ago, the modern art of skiing was born! Also condemning "stem" turns, the first that novices usually learn, he advocates using the "Christiana" alone. His

New Sports Records Set by Science

(Continued from page 118)

edict has stirred a lively controversy among skiing experts, but if he is right it will not be the first time that modern scientific technique has upset old ideas in athletics.

Science has aided sport in developing new equipment, as well as by suggesting changes in technique.

Discuses formerly were cut with the grain running vertically through the thickness of the wood. Now experts have found that these platter-shaped throwing implements will fly farther if the grain of the wood runs horizontally along their faces, and modern discuses are made in this way.

WITH the ash-shafted javelins available at the time of the 1908 Olympic games, the world's record throw stood at less than 180 feet. Then it was found that the flexible shafts cut down the distance by vibrating in flight, and stiff-shafted javelins fashioned from Finnish birch were substituted. Up went the record to more than 250 feet.

Pole-vaulters once used heavy poles of hickory or ash. The weight was too much for them. Americans introduced bamboo poles, and sports figures told a different story.

Queer facts discovered by science about the use of sporting implements may also play a part in future record performances.

Tests made by suspending discuses in a wind tunnel at New York University reveal the surprising information that a discus actually travels farther when thrown against the wind than with the wind. A head wind of seven or eight miles an hour is an asset because it tends to push the projectile up into the partial vacuum created by its own flight and so helps it travel farther.

If you want to make a new record in weight throwing or in broad jumping, suggests Paul E. Kirkpatrick, Stanford University physicist, you should make your try as near the equator as possible, and throw yourself or the weight in an easterly direction. The diminished pull of gravity at the equator, plus the effect of the rotation of the earth, will make an appreciable improvement in your mark. A Scandinavian shot putter, he points out, could expect a heave that would have gone fifty feet at home to travel an inch farther if thrown in the latitude of New York, and two inches farther in the tropics. Throwing toward the east would add another fraction of an inch.

CONSTANT improvements in the technique and equipment of sport are conserving the amount of effort an athlete must put forth and the strain he need undergo to perform record-breaking feats. So it is that in 1938 and the years to come, we may look for shining new accomplishments surpassing anything that has gone before.



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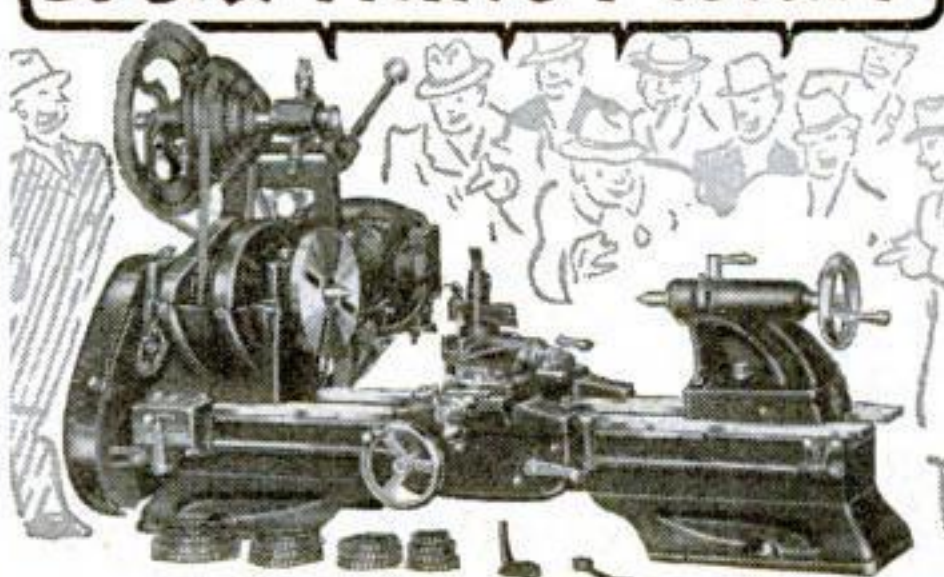
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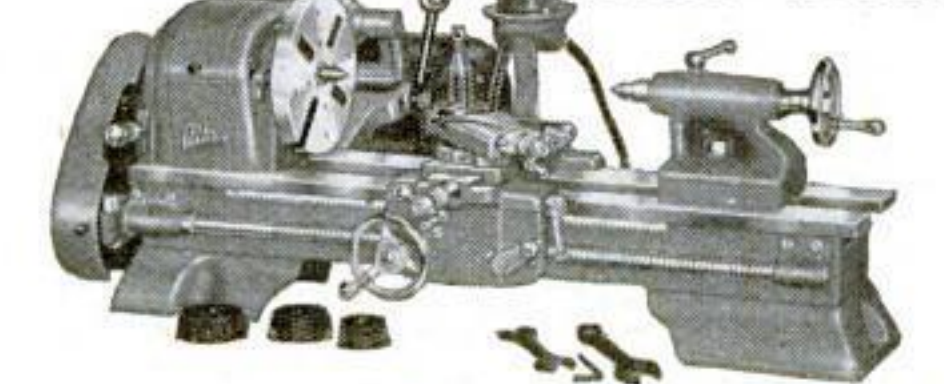
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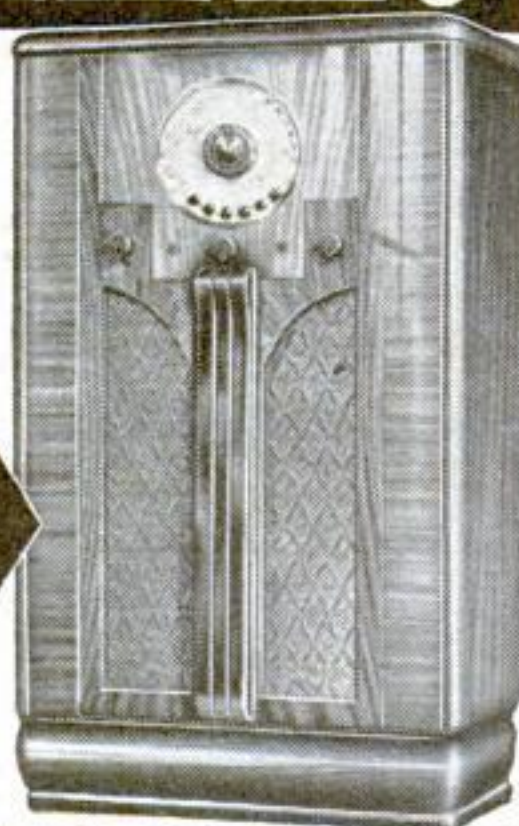
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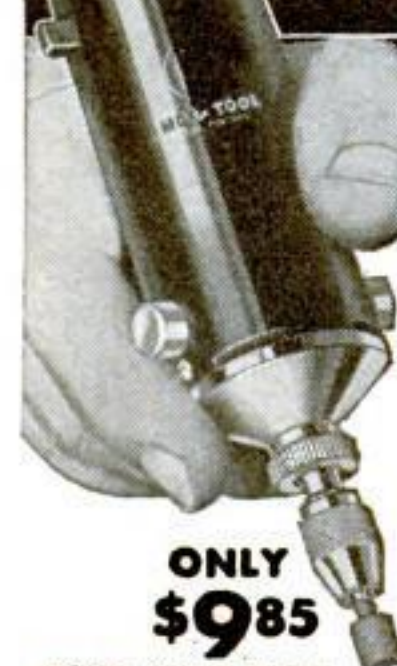
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Building A World's Fair

(Continued from page 37)

twenty-six eastern railroads. Here you will find dioramas, moving pictures, and a huge pageant-drama, "Railroads on Parade." Four thousand persons can sit in the amphitheater facing the stage where the pageant will be given. In a circular hall at one end of the railway exhibit building, a full-size locomotive, its wheels spinning on rollers, will thunder with throttle wide open. In another room, 100 by 150 feet, a complete railroad system will be shown in miniature. Tiny trains and engines, switches and gates, semaphores and stations, will reproduce all the activity of a far-flung transportation system.

FARTHER on, you will see the story of bread dramatized, following the steps from growing grain to finished loaf. In connection with this display, there will be a real field of wheat, a thousand square feet in area. Other exhibitions will show how textiles are made, how automobiles are assembled, how plastics are worked, how various manufacturing and packing activities are carried on. The panoply of the midway, the colorful street of a thousand attractions, will run the gamut of amusements. Already, 6,000 applications have been received for space in this section of the fair. Only one out of six can be accepted.

Of special interest to children will be a world's fair within a world's fair, a juvenile exposition occupying a five-acre tract in the heart of the fair site. Here younger visitors will find an infinite variety of attractions. There will be doll houses, toy rooms, and marionette workshops and theaters. A science-and-invention laboratory will hold hundreds of whirring, clicking models. Those interested in chemistry will find a complete chemical laboratory; those who want to know about photography will have the opportunity of watching experts perform all the processes from clicking the shutter of the camera to enlarging the resulting film. Those simply looking for a good time will be able to take an "amusement trip around the world," trying out in succession the games and sports of many lands.

DURING the progress of the New York World's Fair, special transportation facilities will be provided for the throngs of spectators attracted by the great show. At the present time, an elevated-railway extension is being equipped with a station permitting 40,000 passengers an hour to arrive or leave the fair grounds. The great Triborough Bridge, opened last year, will carry thousands of automobiles and busses directly to the exposition site. New highways will link the grounds with the main arteries of traffic leading from Brooklyn and Manhattan. Special routes will connect the fair with Long Island airports and seaplane bases, so visitors arriving by air can reach the exposition with a minimum of delay. The daily average attendance for the six-months run of the

fair is expected to be 250,000. Facilities are being prepared to handle a maximum of 800,000 spectators a day.

OF ALL the displays vying for attention at the fair, the one which seems likely to attract the largest crowds is the huge structure housing the Medicine and Public Health exhibit. Here you will enter a cathedrallike room, the Hall of Man. It is dominated by the towering, eighteen-foot, transparent figure of a man. Throughout the auditorium, a steady, pulsing sound will be heard. It will be the broadcast of a normal, beating heart, magnified to suggest the sound of the functioning of an organ as large as that shown in the transparent figure, three times life size.

On either side of the giant figure, there will be other, smaller transparent men. Each will be lifelike in every detail. All of the organs will be visible in their proportionate sizes. In addition to revealing how the processes of digestion and respiration work, how our eyes and ears function, how growth and reproduction take place, the models will show, by means of moving lights, how infections spread through the human system.

Another striking display in this same building will be the "vitameter." It will suggest the distance-measuring device on a motor car and will occupy almost one whole wall. Just as the cumulative mileage is recorded on a car's odometer, so the cumulative number of births and deaths during any given week in the United States will be shown on the vitameter. At times, the dial will show that the race between life and death is almost equal. At other times, the birth rate will forge ahead. One purpose of the display will be to dramatize the part science and medicine are playing in reducing child mortality and in lengthening the span of life.

NEAR-BY, visitors will come to a colossal, yawning mouth, large enough to hold half a dozen persons at the same time. Entering, they will walk on a thick sponge-rubber carpet, suggesting a tongue. Around them they will see the teeth in transparent form. They can watch the blood supply circulate, and see how the nerves run through the tooth roots.

To aid the spectators in visualizing the life histories of their teeth, a smaller model of a mouth will be provided. When visitors pull a lever, they will see teeth appear in the same order in which they grow in an infant's gums.

Thus, a little more than a year hence, you will be able to pass from exhibit to exhibit, absorbing knowledge presented in dramatic form. The 1939 exposition, in effect, will be a vast city of science. The building of the fair itself, as well as the preparation of the exhibits it will contain, represents another step ahead in utilizing the latest gifts of research and discovery.

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Very fast utility model

How Human Moles Dig Giant Tunnels

(Continued from page 54)

river-bottom mud and into the water.

In the winter of 1915, the most spectacular accident of tunnel history occurred under the East River, off lower Manhattan. As the crown shield drove forward, it struck a boulder as big as a truck. The impact opened a fissure in the river bottom. In the wink of an eye, the rock, the shield, the whole front of the tunnel, shot upward, carried by the rush of compressed air. Marshall Mabey, one of the sandhogs working behind the shield, heard a roar. The next instant, he was catapulted up through fifty feet of mud and water and hurled into the air. When he struck the water again, he swam to a floating ice cake, miraculously alive after an incredible journey through the bed and water of the river.

Mabey is still building tunnels. So are his two sons, Marshall, Jr., and Albert. The work seems to run in the blood. Families engage in it for generations. Sandhogs often marry into the families of other compressed-air workers, forming a sort of underground aristocracy.

AT THE end of each forward shove, an immense erector arm, mounted on the rear of the shield like the minute hand on a watch, swings 3,100-pound pieces of iron into place where sandhogs, operating pneumatic wrenches, bolt them into a ring that adds thirty inches to the lengthening metal tube. Each of these rings consists of fifteen segments and weighs approximately twenty-two tons. The erector arm, the pneumatic wrenches, and other scientific aids have recently speeded up construction work so that as much as forty-five feet can be added to the tunnel in a single day. In fact, the first of the two tubes was "holed through" four months ahead of schedule.

As you walk back toward the air lock, you meet men pushing hand cars loaded with bolts, tools, and materials for the workers at the shield.

CRAWLING back into the air lock once more, you come to the critical part of your trip. Going out, not coming into compressed air, causes the trouble. Under pressure, nitrogen gas within the body is turned to liquid. When the pressure is relieved, it turns back to gas again, just as bubbles form in a carbonated drink when the bottle cap is removed. Unless decompression takes place slowly enough to permit the body to eliminate the nitrogen bubbles, they lodge in joints and tissues and later produce an attack of caisson disease, or "the bends." The latter name is derived from the fact that a victim bends and writhes in agony in seeking relief from the pains. The remedy is always the same: recompression and very slow decompression.

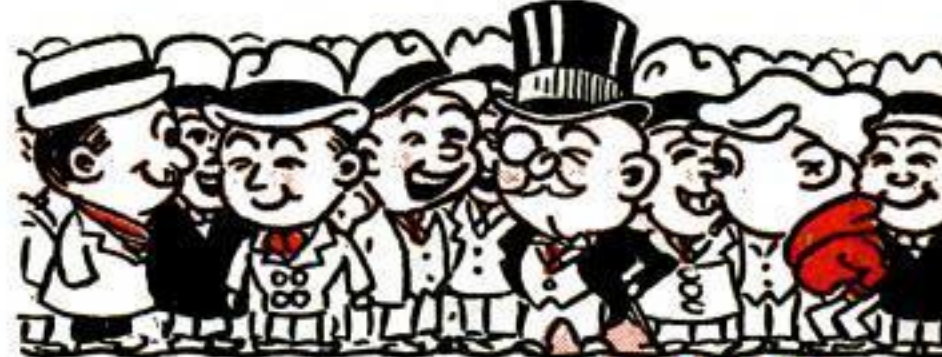
Occasionally, the attacks take strange

(Continued on page 122)

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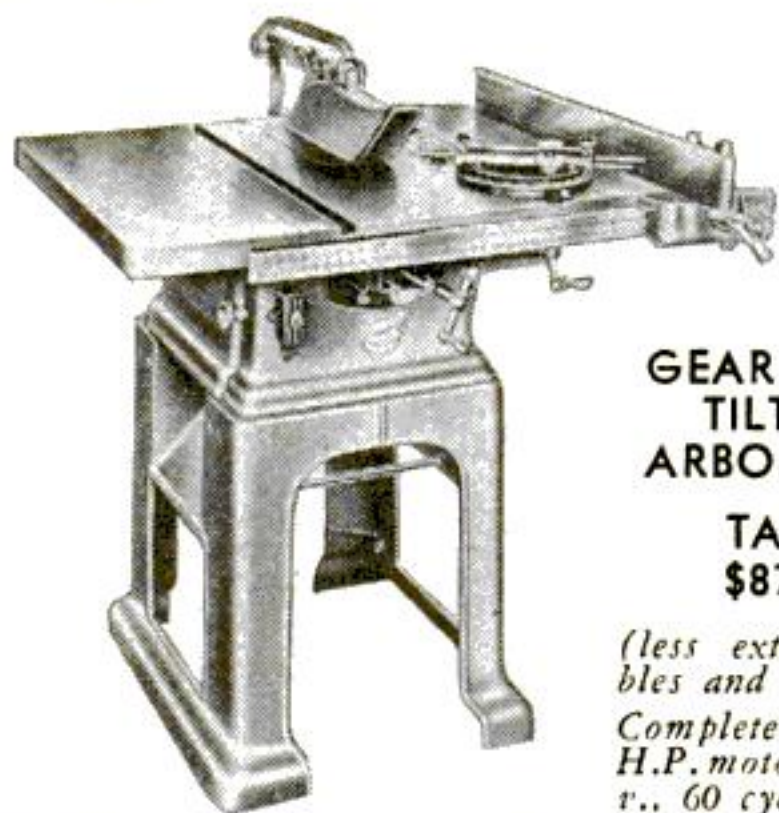
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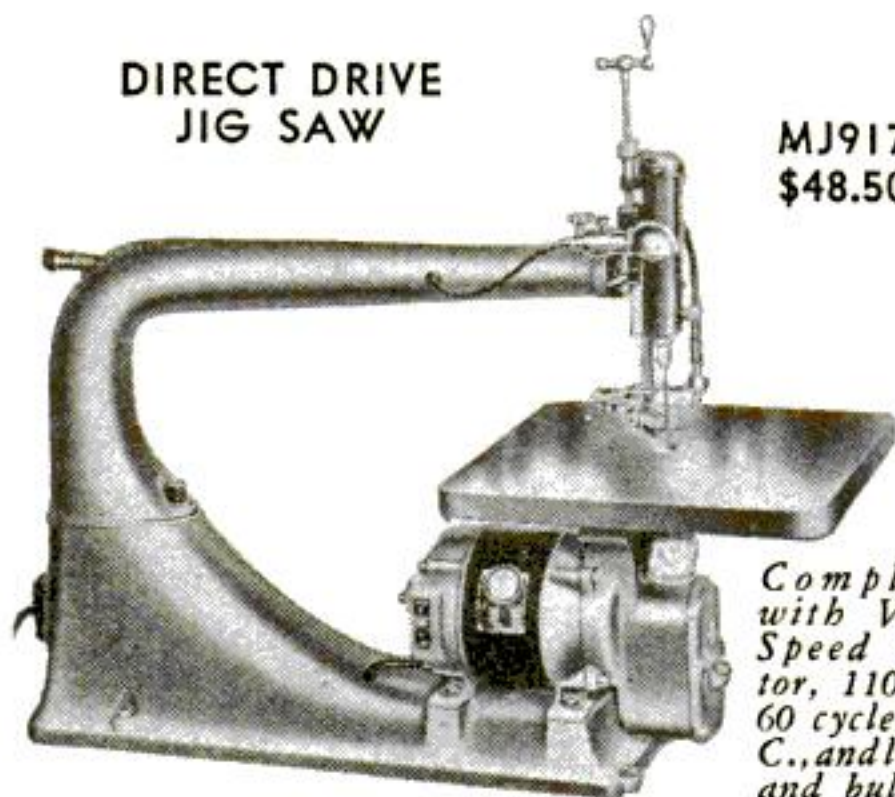
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DRIVER Engineered POWER TOOLS

How Human Moles Dig Giant Tunnels

(Continued from page 121)

forms. In one instance, a sandhog had the bends in his teeth. A bubble had lodged in a cavity. It nearly drove him crazy before he could get back in the air lock. In other cases, the bubbles have found their way into the layers of fat just under the skin. The sufferers were kept scratching as though plagued by the hives. A bubble which finds its way into the spinal column or the brain may produce paralysis.

In the early days, sandhogs attacked by caisson disease were sometimes found on the streets and sent to hospitals or locked up as drunk. Now, every compressed-air worker wears a badge warning those who may find him helpless on the street to rush him to the nearest air lock.

A FEW weeks ago, one New York tunnel worker was driving his car toward the city when he was halted for speeding by motor-cycle cops. He showed them his badge and explained that he was rushing to the decompression chamber with the bends. Instead of arresting him as a speeder, the officers formed a motor-cycle escort. He came tearing through the city in the wake of wailing sirens and pulled up at the air lock to the amazement of his fellow workers. "Curley's ride" has since become a classic story among the sandhogs.

One hundred years ago, when the French engineer, Triger, used the first pneumatic caisson to reach coal at the bottom of a layer of quicksand, almost nothing was known about the effects of compressed air on the human system. The first attacks of the bends mystified the medical profession. Only in comparatively recent years has the cause been traced to nitrogen bubbles.

A frog's foot, curiously enough, enabled scientists finally to see exactly how compressed air affects men. The creature was imprisoned in a small glass compression chamber with a microscope trained on the web of one foot. With strong back-lighting on the membranes, the research workers were able to watch bubbles form and disappear as they suddenly decreased and increased the pressure within the chamber.

DR. EDWARD LEVY, famous New York City authority on caisson disease, told me that no worker is immune to the bends. Unless he observes proper precautions, a veteran is as subject to attacks as a beginner. Fat men are more susceptible than thin ones. Most attacks occur within an hour after leaving work and practically all of them within six hours after returning to normal pressures. Exercise taken during the period of decompression will speed up the elimination of the nitrogen by increasing circulation, and thus aid in preventing the bends.

(Continued on page 123)

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How Human Moles Dig Giant Tunnels

(Continued from page 122)

According to Dr. Levy, three factors govern an attack of caisson sickness: the pressure under which the men are working; the length of time they stay in the tunnel; and the time they take coming out. Under present laws, the time spent "in the air" is governed by the pressure. At sixteen pounds, for example, the men work six hours a day in two three-hour shifts with a three-hour rest between. At fifty pounds, a day's work consists of two half-hour shifts. Incidentally, the higher the pressure, the higher the pay. So, when sandhogs work the shortest time, they get the biggest wages. The lowest pay for tunnel laborers is about twelve dollars a day. The highest, for a superintendent, is nearly \$100 a day. High wages and short working hours are the attractions that bring recruits to the sandhog ranks.

IN SPITE of the dangers of the work, tunnel men often live to an advanced age. One was more than ninety years old when he died. There seems to be no "sandhog type." The men you encounter in a caisson are of all sizes and builds. Some have the physiques of football linemen; others are thin and wiry. Some are young beginners, others gray-haired veterans.

You notice, as you watch the air-lock operator during your trip out, that he keeps his eyes on a clock set close to the pressure gauge. For each caisson pressure, the law sets a minimum decompression time. For sixteen pounds, the time is ten minutes. As the gauge needle swings slowly back around the dial, there is a continual crackling in your ears. The strain on the drums arises now from the fact that the pressure outside the drums is falling faster than that inside. The operator, who spends all his working time going "into the air" and out again, says he is never bothered. He "just opens his mouth once in a while" and that is all.

A CHILL strikes into your body as you leave the heated air lock. According to state law, the construction company has to serve the sandhogs with coffee at the end of every shift. For years, Dr. Levy has been trying to get the men to substitute hot beef tea, which would provide nourishment as well as warmth. But the sandhogs stick to their coffee. Some of them drink pailfuls, believing the beverage to be a preventive for the bends.

As you slip off the brown overalls, galoshes, and helmet, at the end of your trip, you realize in retrospect the hazard and strain of a sandhog's work. But you have also learned how rigid rules, based upon knowledge supplied by research scientists, is eliminating some of the peril encountered by these engineering moles who make our underwater tunnels a reality.

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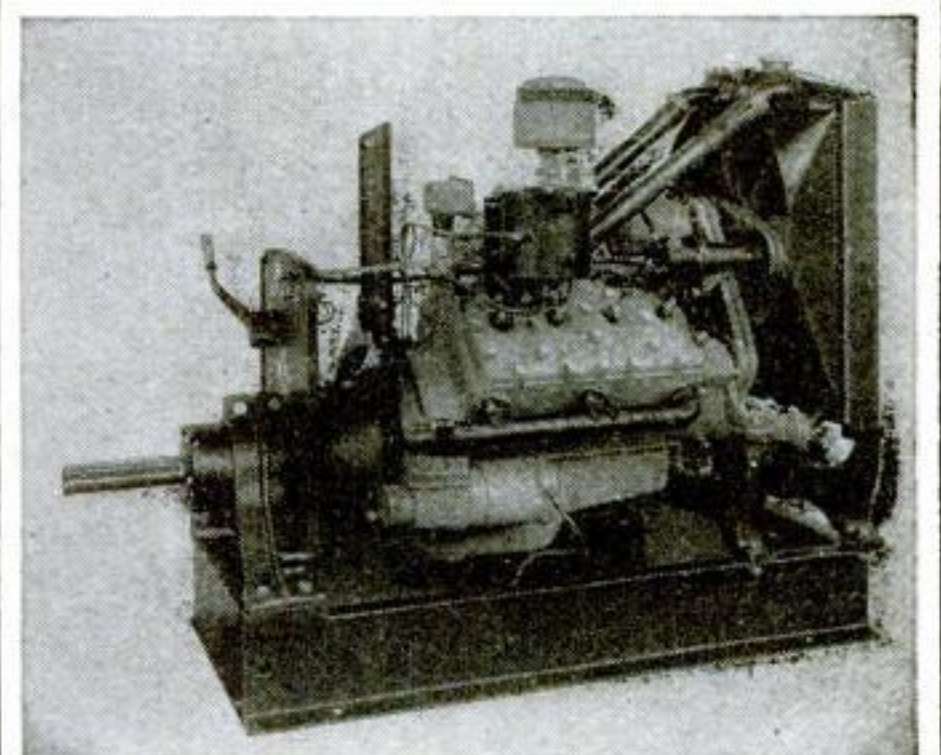


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Above figures show primary fuel costs (lubricating oil not included) for operating a KRW-V8 Unit to develop 50 H. P. for 10 hours per day—26 days per month. Compare this with electricity @ 3c per KWH which amounts to \$340.60 per month. You can pay for a KRW Unit in a few short weeks out of actual savings!

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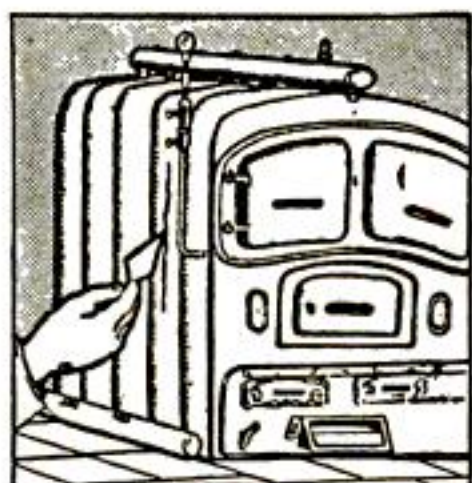
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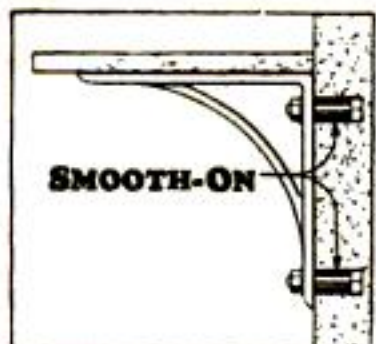
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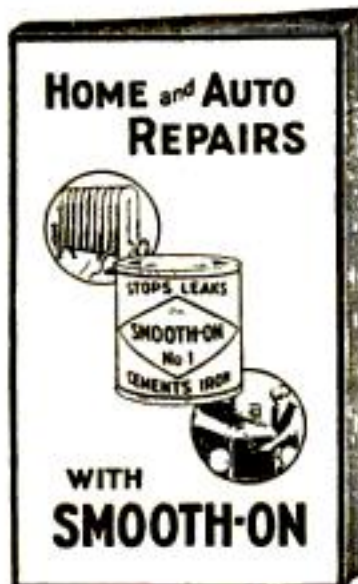
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Experiments with Gold

(Continued from page 99)

in the acid-water mixture previously described. Neutralize some of this solution by adding sodium carbonate until it no longer bubbles or effervesces—taking care to use no more than enough, since an excess of sodium carbonate would precipitate the iron compound.

Now drop in several crystals of sodium acetate, and shake the solution. Finally add some hydrogen peroxide of the ordinary drug-store variety. The brown precipitate that appears, and soon turns darker in color, proves that cerium is present. The same test can be applied to detect whether cerium is present in a gas-light mantle, which you can dissolve in strong sulphuric acid for this purpose.

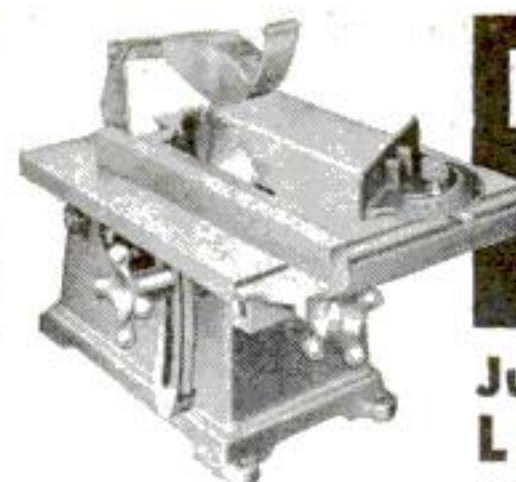
RARE and costly platinum has uses aside from jewelry—and interesting possibilities for home experiment, as well. Photographers use compounds of platinum to obtain various color tones in their pictures. A humbler use for platinum occurs in household gas lighters of the "fireless," nonsparking type. When one of these lighters is held above an opened gas burner, it glows mysteriously and ignites the gas. Protected by a coiled wire guard, the active element of the lighter is a filament bearing a finely divided form of platinum or of palladium, its close relative among the rare metals. Some of the entertaining experiments that can be performed with a "fireless" lighter have been described in earlier articles of this series (P.S.M., May '37, p. 68, and June '37, p. 62).

You can use the rare metal in a lighter of this kind, obtainable at small cost at almost any kitchen-supply counter, to show how alcohol can be converted into acetic acid. This experiment in organic chemistry involves the use of a homemade electric combustion furnace. The device is easy to make, and you can use it in many experiments in which solid or liquid substances interact with gases at high temperatures.

FIRST you will require, for your furnace, a tube about three-quarters of an inch in diameter and fourteen or more inches long. This "combustion tube" may be of ordinary glass, heat-resisting glass, silica, or quartz; the temperature that can be obtained will be limited by the material that you use. Ordinary glass tubing, for instance, will not permit temperatures as high as heat-resisting glass will, but you can employ it satisfactorily in the experiment with alcohol and the gas lighter.

You will need to make a support for the combustion tube from a sturdy wooden or iron bar a foot or so long. Attach it to a burette clamp, so that it may be supported from a laboratory stand. Bolt stiff metal L's to the ends of the bar, and fasten the combustion tube to them by means of sheet-metal bands encircling the tube.

(Continued on page 125)



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Experiments with Gold

(Continued from page 124)

Only the center part of the tube is to be heated. Wrap this portion with a single layer of asbestos paper, which should be fastened in place with thin strips of metal.

The tube can be heated very satisfactorily with one of the coils of resistance wire that are sold for replacing the heating elements of household appliances. These coils are available at electrical stores, and at the electrical counters of ten-cent stores. They measure about eight inches long and are usually rated at about 600 watts; connected directly to the 110-volt house current, they glow with red heat. Wind the coil around the part of the combustion tube that is covered with asbestos paper, stretching the heating wire slightly to get the needed length. Five complete turns will be enough. Bolt the ends of the wire to the strips of metal that hold the asbestos paper in place.

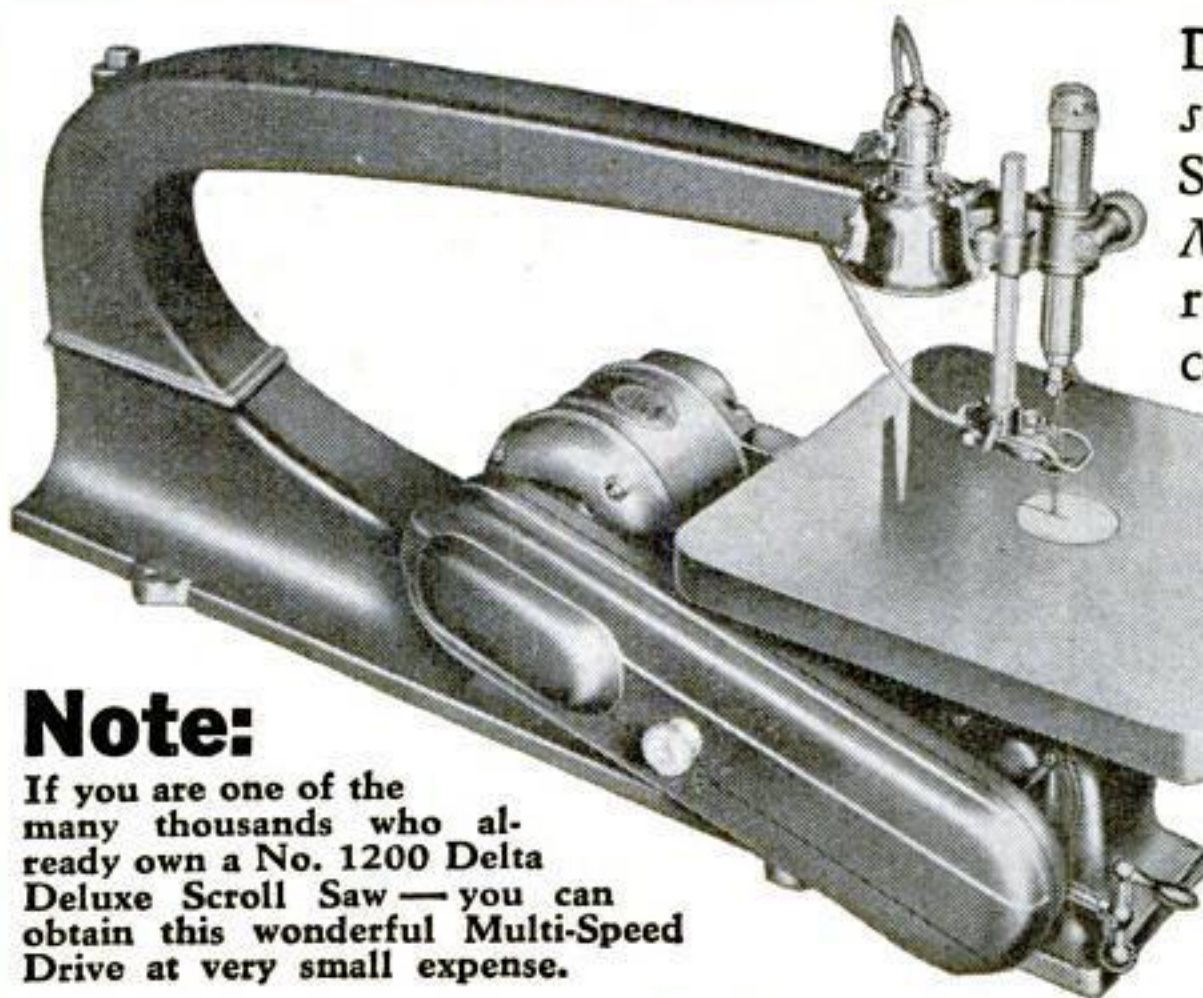
FINALLY, mount a flat-base porcelain electric socket on the supporting bar, and connect it with the electric heating element "in series"—that is, so that all electric current has to pass through both the socket and the element. This gives you a means of regulating the current and the heat of your furnace. For example, if you screw a lamp of sixty or seventy watts into the socket, the tube will be heated to moderate warmth. You will obtain successively higher temperatures by substituting, in the socket, a lamp of 100 to 300 watts; a screw-base heating element of 600 or 660 watts, such as you can buy for about a quarter; a heating element of 1,000 watts; and a fuse of ten-ampere or higher rating. With the fuse in the socket, the heating coil will become red-hot and the furnace will be operating at maximum heat.

If the combustion tube is of heat-resisting material, you can step up the whole range of temperatures by providing the heating element with an outer covering. A length of asbestos or magnesia pipe covering, of the kind used for steam pipes, serves the purpose nicely.

WHEN you are ready to try out your homemade electric combustion furnace, fit it to the side neck of a corked distilling flask, or to a bent glass tube inserted through the stopper of an ordinary flask. A one-hole cork in one end of the combustion tube will make the connection. Put a little ethyl alcohol, such as denatured radiator alcohol, in the flask. Detach a "fireless" gas lighter from its wooden handle and place it in the middle part of the combustion tube, where the heat is to be applied. Insert a strip of blue litmus paper near each end of the tube. Screw a heating element of 600 or 660 watts into the socket, and turn on the current. When the combustion tube becomes warm, start heating the alcohol

(Continued on page 126)

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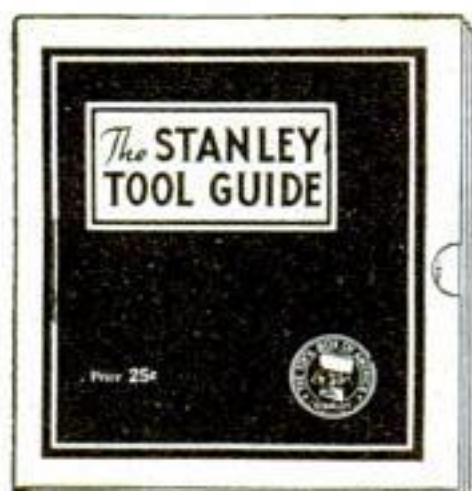
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Experiments with Gold

(Continued from page 125)

in the flask with a Bunsen burner or alcohol lamp.

Alcohol vapor will be driven off, and will flow into the combustion tube, where it will leave the first piece of litmus paper unaffected. As the vapor passes over the hot, rare metal in the gas lighter, however, it is transformed into acetic acid. This is the acid that is present in household vinegar. Playing the role of a catalyst, the rare metal promotes the reaction but is not affected by it. The fact that acetic acid is produced is confirmed by the second piece of litmus paper, which turns from blue to red as the acid vapors pass over it. Other substances such as aldehydes, or compounds intermediate between the alcohols and acids, are also produced in the reaction, and you can detect them by their peculiar odor if you cautiously sniff the air near the outlet end of the combustion tube.

MANY other experiments can be performed with your combustion furnace. You can generate hydrogen, for example, by packing the tube with iron wire or steel wool, and passing a slow stream of steam through the hot furnace.

Whatever the limitations of your purse, experiments like these show, you need not deny yourself the fun of experimenting with even the rarest of materials. The fact is that amateur chemistry, like many another fascinating hobby, can cost you just about as much or as little as you choose. If fine, expensive glassware and high-priced chemicals are beyond your reach, you can supplement modest purchases from dealers with surprisingly serviceable pieces of homemade apparatus, and with a plentiful variety of chemicals to be found right in your own kitchen, medicine chest, and workshop.

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Seeing Through Coal with Your Microscope

(Continued from page 97)

to a point where the specimen will be difficult to polish.

Now polish the specimen on successive stones and a cloth lap as before. When you have worked it down to a thickness of a few microns (thousandths of a millimeter), you will find that some places are thicker than others. With a little patience, you can use silver polish or some other abrasive and a cloth to work these spots down. In this, as in all other polishing operations, make frequent examinations with your microscope. Many specimens can be ruined by making them too thin. When the details appear to be satisfactorily rendered, and the surface smooth enough, discontinue the polishing operation.

BEFORE mounting your specimen, you probably will find it desirable to remove it from the glass support and clean it. Immerse the support in xylol or dioxan, to dissolve the balsam. With fine-pointed tweezers, very carefully remove the specimen and transfer it to its new support, washing further in the solvent to remove bits of dirt if necessary.

It may be possible, as usually is done with coal, to leave the specimen cemented to the support, and simply add a little balsam and a cover glass. In such cases, the support of course should be a standard microscope slide. Even though it might be desirable to loosen the section and wash it to remove particles of dirt, some specimens are so fragile that it is unwise to attempt this.

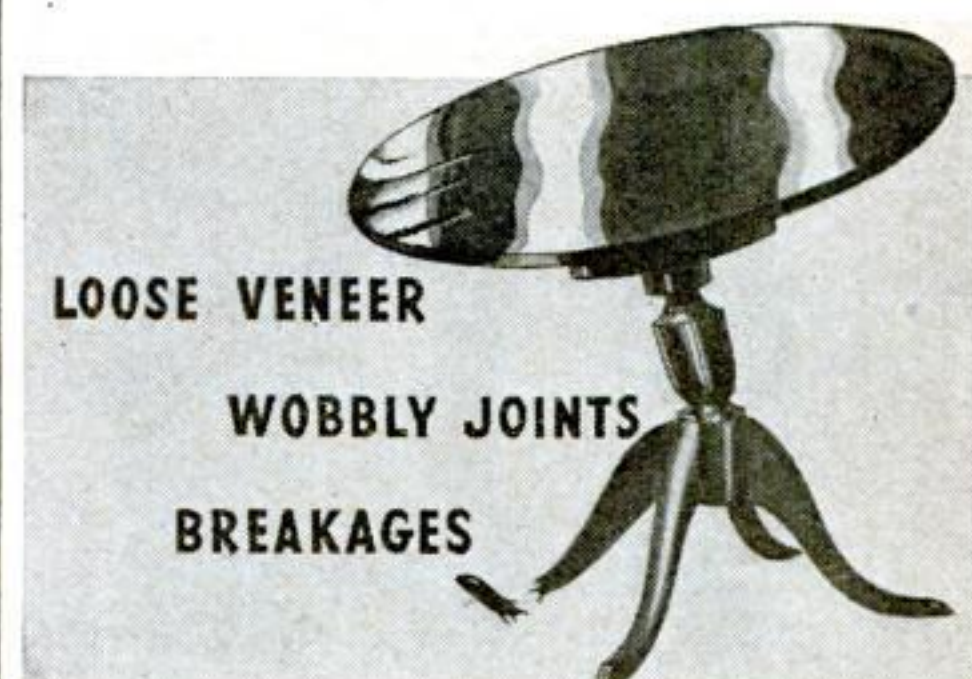
Mounting is one of the most important steps in the process, for the final appearance of most specimens depends on the way they are mounted. Sometimes the use of balsam as a medium will destroy detail, while at other times it will amplify it. As an example, cross sections of bone show tiny openings that resemble pores. In air, these appear as dark spots, while in balsam they may be scarcely visible. Therefore, bone sections usually are best when mounted dry, or when mounted in balsam in the following manner:

COVER both the cover glass and the slide with balsam, and heat it until it hardens upon cooling, just as you did when cementing the specimen to the glass support before grinding and polishing the second surface. Lay the section of bone on the balsamed surface of the cool slide, and lower the cover glass, balsam side down, over it. Now gently heat the assembly, and when the balsam is liquid (it should not be flowing) press the "sandwich" together, so that good contact is obtained. Let it cool. If the job has been done properly, the balsam holds the specimen securely, but has not flowed into the tiny openings to obscure them. You can add balsam around the edges of the cover

(Continued on page 128)



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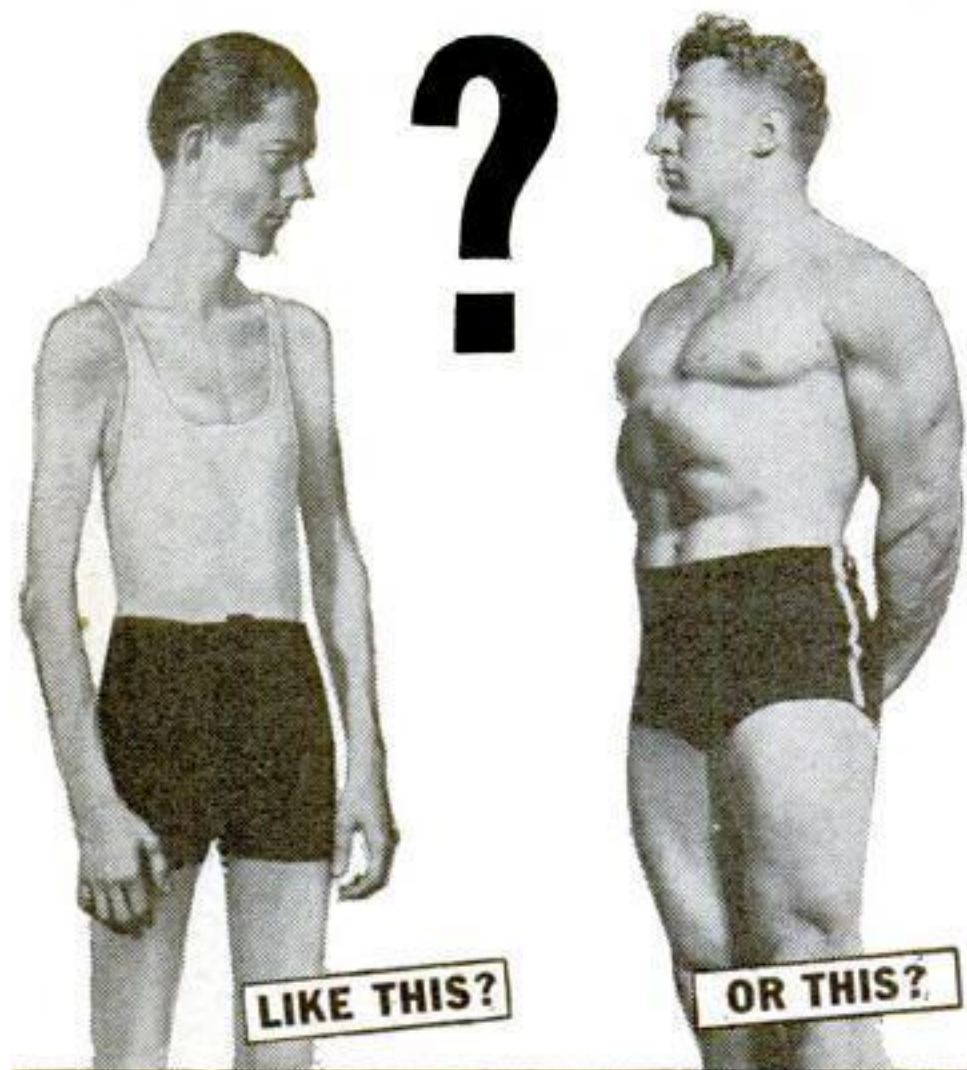


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Seeing Through Coal with Your Microscope

(Continued from page 127)

glass, to fill any surrounding spaces.

In this way, you can unearth secrets of nature that otherwise would remain hidden from your sight forever. You will be following steps identical with those taken in research laboratories devoted to the study of coal, fossils, and bony materials (P.S.M. Oct. '36, page 34).

COAL, for instance, probably will surprise you, for you have been thinking of it all along as a black, uninteresting mass. Your first surprise may be to learn that coal in thin section is not necessarily black, but may be red or yellow. Scattered throughout the coal you may find such objects as the yellow, flattened spores of ancient plants, pollen grains, red clumps of fossilized resin, leaf fragments, woody particles which usually are red in color, and various other plant fragments—for coal is a material made from the remains of ancient vegetation. Your chances of finding ancient seeds in coal are slim, for most coal-forming plants were much too primitive to form seeds.

The spores in coal have been distorted from their original shape by great pressure. They originally were round, but pressure that reduced the deposits of plant remains to thin layers has flattened the spores into tiny, double-walled pancakes. Such spores may appear as tiny yellow disks or as flattened loops, depending on the direction in which they were sliced.

Although you can slice bones in any direction, cross sections generally reveal more interesting details. You will find that typical bone structure looks as if it had been built up of parallel rods cemented together. In the center of each rod is an opening, the Haversian canal, through which blood vessels and nerves pass when the bone is living.

AROUND these canals are concentric striations, something like the rings of a tree trunk. Scattered through the area are tiny spots which may appear black, but which really are minute openings. These are the lacunas—cavities occupied, in the living bone, by bone cells or "bone corpuscles." These are the openings that balsam renders difficult to see when it is used as a mounting medium, although they and the canals may be filled with debris from grinding, and appear black. Threadlike processes interconnect them, so that the cells form a network that receives nourishment from the blood vessels in the Haversian canals.

The microscopic study of bone is an important job of science, for it leads to discoveries of importance in the treatment of diseases and in better understanding the animal body. Microscopists skilled in the study of bony materials can identify small fragments, for bone structure varies in different animals. The microscope can be used to catalogue bones from prehistoric deposits.

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Why We Dream

(Continued from page 46)

rule, persons who are healthy have pleasant dreams; those who are sick, the reverse. Children under four years of age have few, if any, dreams. The greatest activity of the sleeping mind occurs between twenty and thirty-five. Persons beyond sixty-five years of age have comparatively few dreams and most of them concern scenes and activities of the distant past.

SOME people can recall as many as ten dreams they have had the night before. The vividness of these imaginary experiences varies widely. Women, as a rule, dream more and with greater vividness than men. The average length of a dream, one research scientist calculates, is approximately thirty seconds. The whole action of a long train of visioned events may appear before the mind's eye in a flash.

A classic example is the dream of the English novelist, Charles Dickens. In it, he imagined he had died and saw himself taken to an undertaker's establishment where men worked for hours sawing and hammering to make a casket. One of the men dropped a board and Dickens saw himself come to life.

He awoke and found he had been dozing in an arm-chair. Outside his window, a carpenter, making a garden fence, had just dropped a board. The whole dream had transpired during the moment he was regaining consciousness.

While not all dreams can be accounted for by physical stimuli—many arising from the mysterious realm of subconscious personality—a large share of the most familiar visions can be traced to understandable, physical causes. The mind, in trying to account for the sensations of the body, produces these fantastic explanations we call dreams.

POPULAR SCIENCE Question Bee

How did you fare in the Question Bee on page 68? Correct answers are indicated by the letters alongside the numbers below. To find your score, give yourself four points for each one you had right. A total of 80 to 92 is good, and from 92 to 100 is excellent.

QUESTIONS

- | | | | | |
|------|-------|-------|-------|-------|
| 1. c | 6. c | 11. c | 16. a | 21. b |
| 2. d | 7. c | 12. e | 17. b | 22. a |
| 3. b | 8. b | 13. d | 18. b | 23. b |
| 4. c | 9. d | 14. a | 19. c | 24. a |
| 5. c | 10. b | 15. b | 20. b | 25. d |

PICTURES

- | | |
|-------------------|--------------------|
| 1. escutcheon pin | 5. furniture glide |
| 2. lag screw | 6. wood screw |
| 3. flat-head nail | 7. brad |
| 4. stove bolt | 8. carriage bolt |
| | 9. carpet tack |



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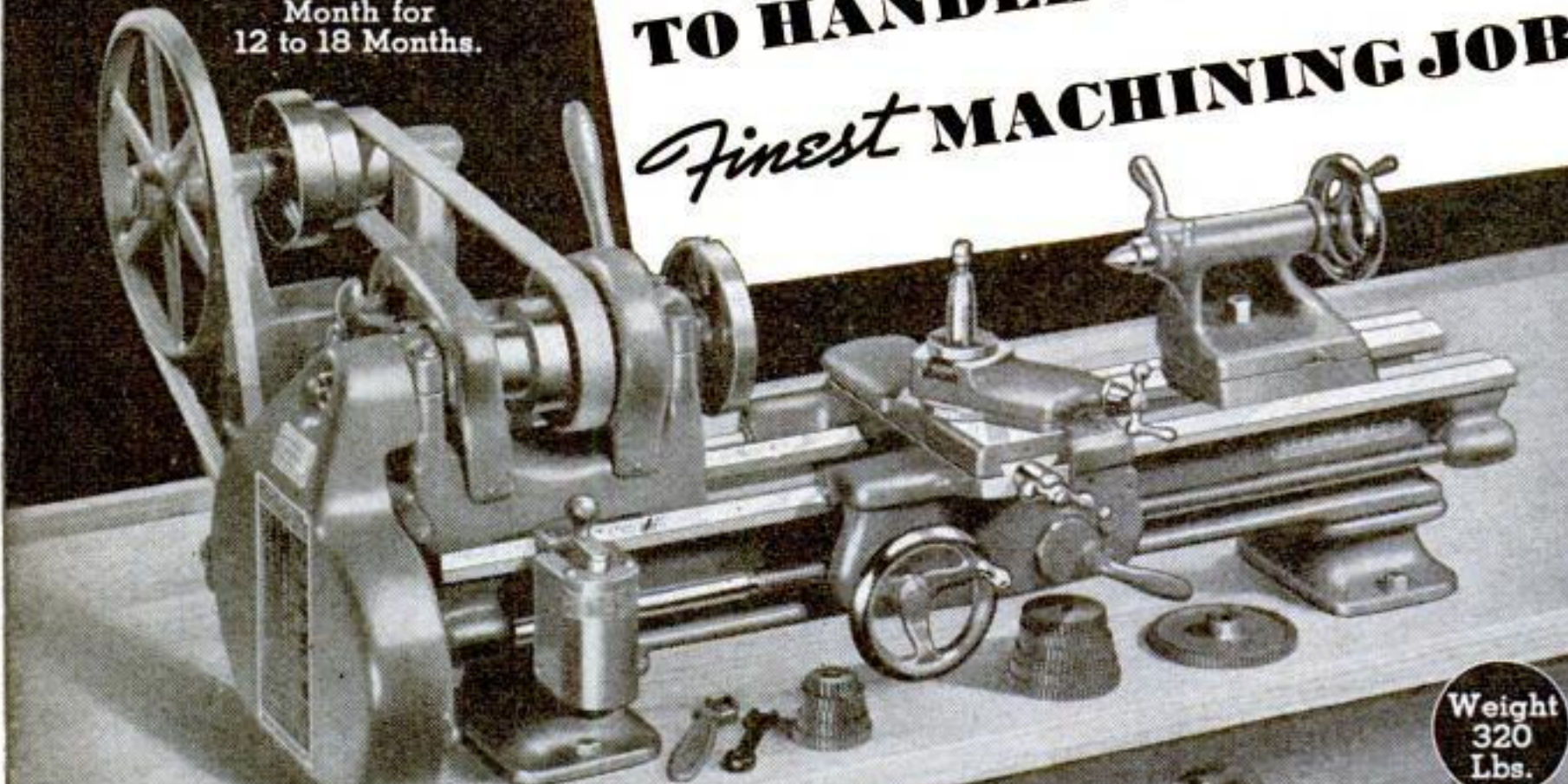
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Birth of a Volcano

(Continued from page 95)

more as the result of the friction caused by the pressure.

Since the pressure continues to increase, eventually a crack is produced through the strata of the limestone arch, and through this crack the lava is squeezed upward to the surface of the earth. A volcano, spouting out molten lava, has been created out of strata of soft but solid rock!

THIS illustrates the formation of volcanoes in rising mountain ranges, but there is also a type of volcano in which the strata are not bent, but merely fractured. A block of crust becomes cracked loose from its surroundings, as shown in the diagram. Wedging between adjacent blocks, it is pushed upward, relieving the shale beneath of the pressure which has kept it solid. Then the softer rock melts and flows upward and out upon the earth's surface. This is the quiet type of volcano, which merely pours its lava out upon the surface.

But, instead of a single long crack in the crust, there may be two or more, intersecting approximately at right angles. Then the volcanoes are apt to melt out "chimneys" for themselves at the intersections, and produce "cinder cones."

The sketch map of the Galapagos Islands shows thirteen principal volcanoes, arranged in straight lines which intersect almost at right angles!

Our final experiment illustrates how a volcanic mountain is formed into its characteristic conical shape by a gradual accumulation of cinders, ash, and bits of hardened lava, all blown up out of the volcano's chimney.

For the foundation of your miniature Vesuvius, make a small hole in the center of a metal disk and mount the disk on three dowel-rod legs as shown in the accompanying photograph. Bore a vertical hole through a block of wood, and another hole slanting down from one side until it meets the vertical one. This block is fastened to the bottom of the disk so that the vertical hole coincides with the hole in the disk.

TO THE other end of the vertical hole attach a rubber tube to connect with the rubber bulb from a large atomizer. Insert the point of a paper funnel into the slanting hole in the block and fill the funnel with powdered soap. A broom straw or pipe cleaner thrust down the funnel will help to move the soap down to the chimney of your volcano.

Now start the "eruption" by squeezing the bulb. The powdered soap is shot high into the air and falls on the disk around the vent.

If you have enough patience to keep blowing for two or three hours, you can build a very respectable volcanic mountain in the same way in which nature has built such peaks as Shasta, Lassen, Hood, Rainier, Fujiyama, Vesuvius, Etna, and thousands of other volcanic summits that are scattered all over the world.

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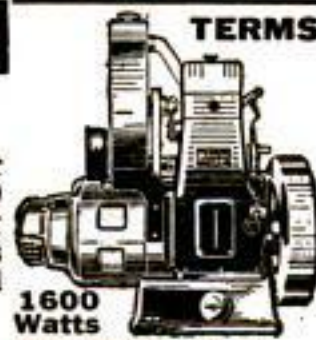
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This One



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Gus Says: Stop Your Starting Troubles

(Continued from page 72)

and begins burning up both of us!"

He lifted the hood, snapped a length of cable onto one of the battery terminals, and touched the other end of the cable to a terminal of the starting motor—it turned over with a whirring rumble.

"Thought so!" Gus grunted. Your battery was pretty well down, all right, but not so bad that it wouldn't have given you juice enough to start. It's your starting switch that has gone bad." He swung a wire-guarded electric lamp under the hood, peered inside, and wrinkled his nose in disapproval. "Sure, there's your trouble—dirty contacts on the starting switch. And are they dirty!" He cleansed them quickly, closed the hood, replaced the battery compartment cover, hopped in, turned the ignition switch, and stepped on the starter. In an instant the engine was running sweetly.

"THERE you are, mister!" he said. "Get in, and go on to your dance. You don't even have to tell Peggy that it wasn't my thick-headedness that held you up so long!"

Gus had just taken Jack Simpson's battery off the charging line, the next afternoon, when Peggy Knowles came in.

"Have a nice time at the dance last night?" he asked, grinning at her.

"Wonderful!"

"Your boy friend get his car started all right coming home?"

"Of course," she said. "And he told me that he had been sort of snooty to you, and that you'd told him where to head in. He's coming around to get his battery pretty soon, and to try to make up with you. I'm afraid he doesn't know much about cars, Gus—except just driving them. I wish you'd tell him a few things when he comes in—about batteries, and starters, and so on. I just hate it when a car won't start!"

"So did Mr. Simpson," grinned Gus. "But I'm afraid that he won't be interested in the details of keeping his connections tight, putting water in his battery, and such."

"Maybe he isn't interested in them—but I am!" said Peggy. "You see, Gus, we're going to get married—and we'll have plenty of things to do with our money besides handing it over to you and Joe to pay unnecessary repair bills!"

"THAT does make things different," agreed Gus. "All right, Peggy—I'll tell him anything he wants to know."

Jack Simpson drove into the garage about a half hour later, and came into the shop smiling broadly. "I'm sorry about last night, Mr. Wilson," he said. "I didn't know that you and Peggy were such old friends. And I was sort of upset about my darned old bus not starting. No hard feelings?"

"Not a one," said Gus heartily. "Well,

(Continued on page 132)

here's your battery—all recharged, and all ready to run down again if you don't take better care of your electrical system. If you want to leave your car here for an hour, I think that I can save you some money and a lot of future trouble by checking your wiring.

"Fine!" agreed Simpson. "Let me stay here while you're doing it—and tell me something about how to stop starting trouble."

"THE best time to stop it," said Gus, carrying the battery over to the car, "is before it starts—same as most other car troubles.

"So far as the battery itself is concerned, you don't have to worry much about it. Just remember to have it checked once a month—maybe once in three weeks would be better in really hot weather. If the hydrometer reading is above 1.225 and the same for all cells, all you need to do is have distilled water added to take the place of what has been lost by evaporation. If the hydrometer reading is below 1.225, and the same for all cells, your battery needs recharging. But if the readings for the different cells vary considerably, have your battery taken out of the car and given a more thorough test. The chances are that it is worn out and you need a new one.

"No matter how good a storage battery is, or how fully charged it is," Gus went on, as he put the cables in place, "you can't take more current out of it than your generator stores in it while your car is running. Every time you toot your horn, or light a cigarette with your electric lighter, or play your radio, or use any of the other electrical gadgets you have on your car, you take some current out of the battery. If you drain it too much, you won't have enough juice left to get action when you step on your starter. Remember that cranking your engine requires anywhere from 100 to 400 amperes for a few seconds—something like forty times as much current as you use to operate all your lights.

"IF YOU'VE got the right battery for your car—and for your collection of electrical gadgets—you may still get in trouble through your current leaking away. I see that you've got an electrical clock, and that although it's connected it isn't running. You'd better either get it going or let me disconnect it. An electric clock that's running doesn't use enough current to bother about, but one that is connected but not running may drain as much as three ampere hours a day out of your battery."

"Gosh, I'm glad you told me," said Simpson. "Suppose you disconnect it until I have a chance to get it fixed."


"Then there are short circuits," Gus continued. "They'll kill any battery,

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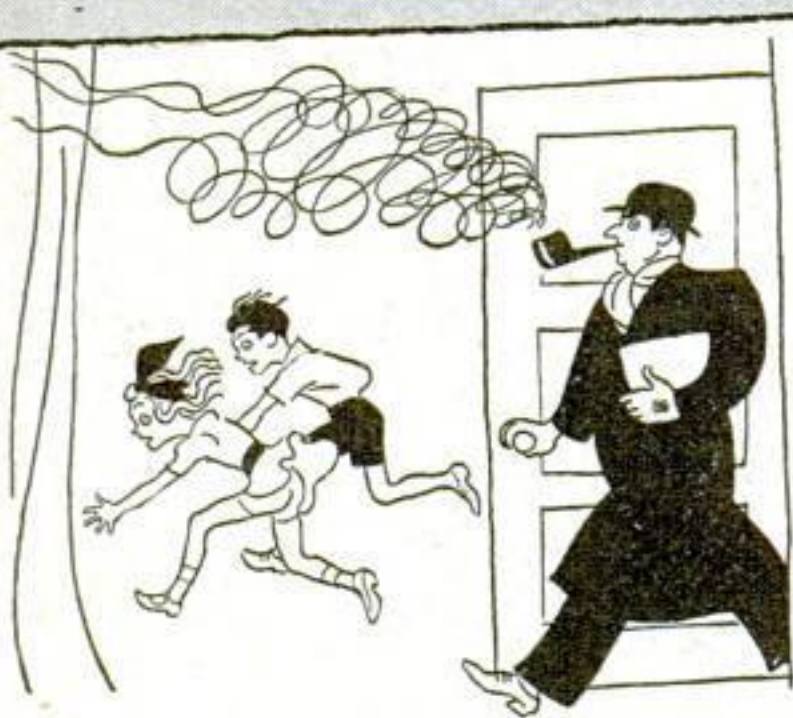
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Gus Says: Stop Your Starting Troubles

(Continued from page 131)

and do it quick. They're easy to check for. First, check your stop light and make certain that it's not stuck. Next, check your fuses and see that they haven't been burned out. Now switch all your electrical equipment off. Make sure that the ground strap—that's this braided wire cable that connects one of the terminal posts of the battery to the frame of the car—is connected. Now tap the other terminal clamp against its battery post. See it spark? Just as I thought—you've got a short circuit somewhere. Let's see now—here it is! Insulation worn off this cable. Might have set your car afire!"

"SO THAT'S the reason why my battery ran down!" Simpson exclaimed. "It's a mighty good thing you made this check-over!"

"Next," said Gus, "I'll just clean and tighten these connections, so that the current can flow through them freely. That finishes the check on your wiring. You should have that done every 10,000 miles that you drive.

"Now, suppose you know that your battery is fully charged, and that your wiring is all right, but still your starter won't work. Remember how I found that dirty contact in your starting switch last night? Always look for that.

"If your starting switch is all right, maybe the trouble is with the brushes of the starting motor. Cleaning the brushes and the commutator probably will do the trick.

"Sometimes the starting motor spins when you step on the starter, but still your engine doesn't start. Better take the starting motor out of the car, and give it a good looking over. Maybe the pinion gear is too tight—or maybe its spring is broken, or its teeth broken or clogged with dirty grease. But you needn't worry about any of those troubles—not just now, anyway!

"Now I'll just take a look at your spark plugs—if they're fouled or out of adjustment they make starting harder than it should be. Better have them checked every 10,000 miles. No—they're O. K."

GUS straightened up and wiped his hands on a piece of waste. Then he picked up the battery he had just removed from Simpson's car, and started across the garage toward the bench supporting the charger. "Well, you won't have any starting troubles for quite a while now, Mr. Simpson," he said.

"Oh, make it 'Jack,' won't you?" said Simpson. "I've an idea that I'll be coming in to see you pretty often!"

"Always welcome, Jack," said Gus. "We'll take your money when we have to—but I like to help a young fellow keep his car running without it being too tough on his pocketbook. Especially when that young fellow is going to marry a fine girl like Peggy Knowles!"

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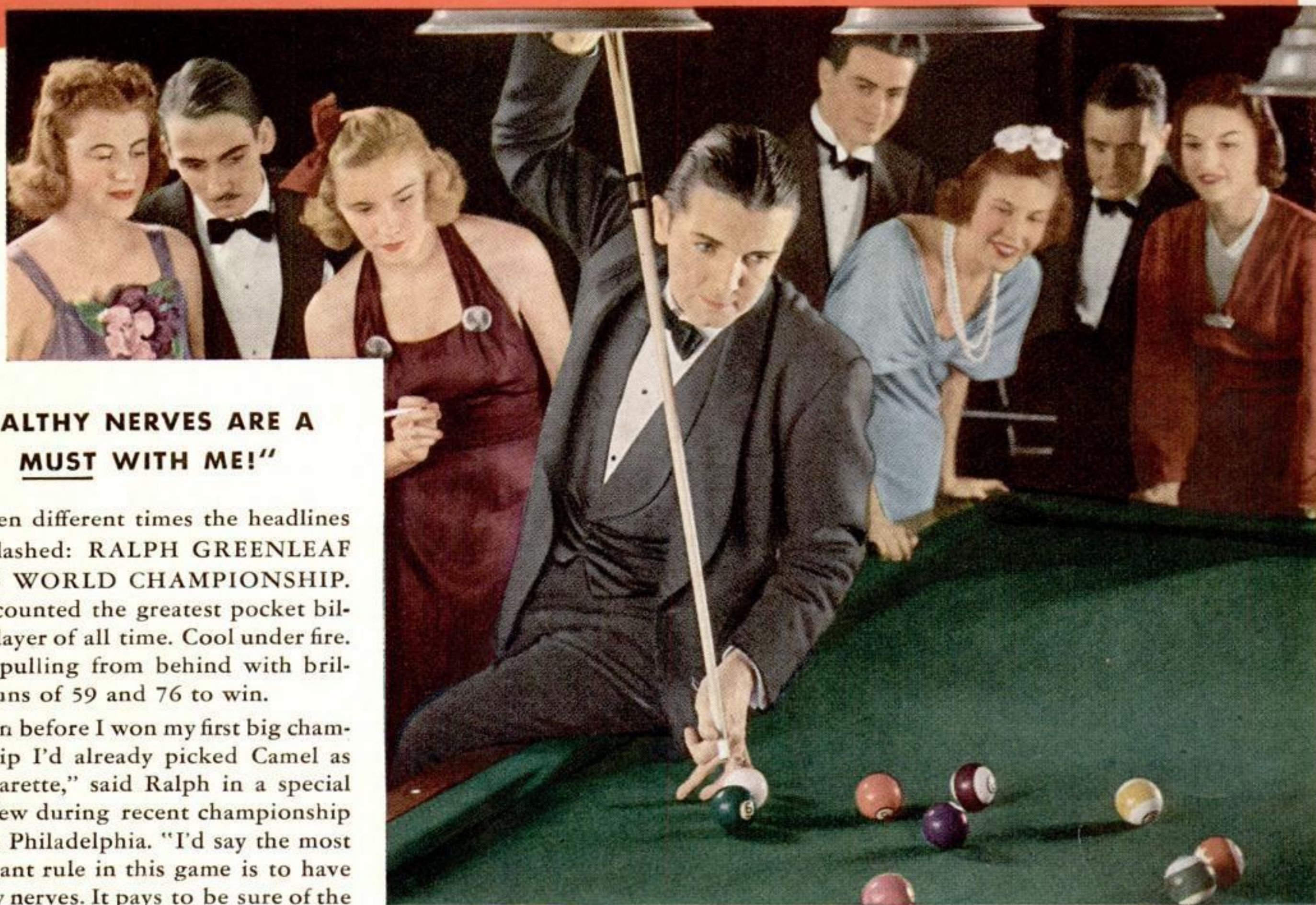
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